Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XLIII. NEW YORK, SATURDAY, MAY 28, 1904. No. 22.

ELECTRICAL WORLD AND ENGINEER

Published weekly by the

McGRAW PUBLISHING CO.

114 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 7605 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

EDITED BY T. C. MARTIN AND W. D. WEAVER.

CHICAGO OFFICE - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE - - - - - 929 Chestnut Street.
EUROPEAN OFFICE, Hastings House, Norfolk St., Strand, London, Eng.

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ELECTRICAL WORLD AND ENGINEER.

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Change in advertisements intended for a particular issue should reach the office of ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue. New advertisements can be received up to noon of Tuesday of the week of issue.

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United States, Canada or Mexico - - - - - - Per year, $3.00
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Entered as second-class mail matter at the New York Post Office.

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Boston Convention of the National Electric Light Association.....Supplement

SCOPE OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

It is probable that the range of topics touched upon by President Edgar this week at the Boston convention of the National Electric Light Association will surprise many who read his address. A great many important plans and topics are touched upon in a suggestive way, and a little thought will show that all of them fall legitimately within the scope of the body, whether regarded as a congress of large public service corporations or as the technical exponent of a great modern engineering industry. In fact, the opportunities and the responsibilities of the Association have grown, *pari passu*, with the wonderful expansion depicted by Mr. Edgar so briefly but so graphically; and if the Association does not go forward to larger usefulness, it must necessarily go back. This latter it will not do, if Mr. Edgar's fine address be any indication, or if we know aright the temper and quality of the men now administering the affairs of the Association and determining and shaping its policy.

Particularly do we like the broad gauge of Mr. Edgar's reference to the desirability of enjoying the hospitality of the Union Engineering Building in New York City, as headquarters for the Association; and his proposal to form a new class of members. In both respects this is an indication of that largeness of policy to which the growth and prosperity of such a body must always be due. It is well that the Association should thus put itself in touch with the other national engineering societies of the country, with consequent uplifting of its aims and motives. It is equally well that it should provide against the process of dessication and shriveling up that would inevitably attend a decline in even the mere numbers of membership. The drawing together of small lighting companies into a limited number of larger corporations is a fact and a sign of the times, and powerful associations have suffered from such a change, to the hurt of the public and to their own injury. Mr. Edgar's plan for keeping the membership full and alive with active men commends itself to our judgment, as doing what is needed to maintain the Association as a forum of lighting discussion and as an authoritative mouthpiece of the distribution art in general.

Such admirable papers and discussions as were presented this week are in themselves an argument for the wider membership that President Edgar advocates, and while we are glad to note the continuing share in the proceedings of many of the veterans, the happiest augury after all is the participation of new men so numerously. It is to them that the Association must look for its development and vigor in the years that are to come. Indeed, Mr. Edgar and the officers are to be heartily congratulated upon the attendance of the younger men in such numbers, and their keen interest in all that went on. It was notable that they read a large proportion of the papers and took a large part in the discussions—and hence in no slight degree was the brilliant success of a memorable convention achieved.

THE CONVENTION PAPERS.

The programme placed before the Boston National Electric Light Convention this week contained no fewer than 27 entries of papers and reports, including a "Question Box" which for full consideration would alone have taken up no small part of the entire time set for the disposal of the programme. By far the most valuable contributions to the proceedings are this "Question Box," and the hundred odd pages of "Wrinkles" which the indefatigable editor of this new department of the Association's work, Mr. Charles H. Williams, had

gathered through correspondence with central station men. The amount of live information of direct practical value to central station men contained in the "Question Box" and "Wrinkles" should alone give a money value to the printed *Transactions* much in excess of the annual dues for membership in the Association. We believe, however, that somewhat more discrimination in the admittance of queries to the Question Box would conduce greatly to the permanent success of this valuable feature. At present too large a proportion of the questions are of a kind to which the querist could have found answer by reference to books which every electrical man worthy of serious consideration should have at hand, or relate to matters that from their scope or importance call for the services of a consulting engineer rather than free advice through this channel. Unless a change is made in this respect, we fear that those who would otherwise be glad to continue to supply answers to questions, will in time find their interest slackening. Of the other items on the programme, the report by Mr. Arthur Williams on "Sign and Decorative Lighting," and that by Mr. La Rue Vredenburgh on "Advertising Methods," will doubtless be found of keen interest by the more enterprising class of central station men. The time has certainly arrived when further considerable extension in central station supply will only come through the introduction of methods for extending business such as prevail in other branches of affairs; that is to say, every increase of business must depend largely upon methods for awakening the interest of possible customers and in subsequent solicitation of their trade in an intelligent manner.

To be properly prepared, however, to take full advantage of the possibilities of a campaign of publicity and individual solicitation, the central station man should know exactly every item which affects the price at which he can sell current profitably. Mr. Frank W. Frueauff, in a paper on "Office Methods and Accounting," has, in a well-written paper, set forth one aspect of this side of the situation, namely, that relating to a system of accounts whereby the central station manager may determine exactly the cost of electrical energy under any condition of service; and Mr. C. W. Humphrey, in an admirable report on "Lost and Unaccounted-for Current," pointed out the manner in which distribution losses may be segregated, thus enabling savings in this direction to be made, which in turn may permit of reductions in rates with consequent increase of business. It is notable that both of these eminently useful papers were written by members of the staff of the Denver (Col.) central station, where Mr. H. L. Doherty has, by the introduction of new methods, been enabled to increase enormously the output, following progressive reductions of rates doubtless fixed by analyses such as those described in the papers referred to, coupled with broadly conceived methods of publicity and personal solicitation of custom. Of the other papers, only two stand out with any prominence, namely, that of Mr. Eastman, upon which we comment below, and that of Messrs. Andrew and Wells, giving the result of an economy test of one of the 5,500-hp generating units in the New York Waterside Station. Indeed, the programme would have been very much strengthened by the absence of quite a third of the papers which it carries.

Effects of Grounding High Potential Lines.

Mr. Eastman's N. E. L. A. paper upon this topic is singularly timely. So many high-potential polyphase systems with more or less underground conductor are now in use that questions of capacity, rarely serious on the older circuits, become of the first importance. How important they may be under common practical conditions Mr. Eastman's paper clearly shows. It must be remembered first, last and always, that the sources of trouble on high-voltage circuits are abnormal and not normal conditions. In the purely academic discussion of alternating currents the student, and even the average well-trained engineer, is too apt to get a fixed idea that the capacity and inductance of the line as such is of the first order of importance. On the contrary, the line is often of relatively small importance compared with the apparatus connected thereto. A modern high-voltage generator or transformer can furnish, when grounded, pretty high values of inductance, resistance and capacity according to the particular way in which it is constructed or misconnected. Accidents of a very simple kind are, moreover, capable of starting vicious surging, so that abnormal potentials are, as experience shows, rather common upon high-voltage alternating circuits. Every accident, every change of load even, produces disturbance of the potentials, generally trivial, but sometimes of serious magnitude. And where as in the admirable four-wire, three-phase system there is a neutral conductor, its potential relations may be seriously disturbed even while the voltages of the system remain in fairly close accordance.

This case is the one particularly investigated by Mr. Eastman, who has worked out the potential relations between ground and neutral under various hypotheses as to the resistance, reactance and condensance of grounds on one phase wire. The upshot of the matter is that under certain conditions which may occur in practice, the voltage between neutral and earth may rise to dangerously large figures, which, particularly in underground distributions, would be likely to lead to serious trouble. It is, we believe, the common experience of those operating high-voltage alternating circuits that at times there become evident potentials altogether greater than any which normally belong to the system. At an earlier stage of the game these were charged up to "static," which meant anything and everything from lightning to a leaky switch base. Later there was a disposition to lay everything to resonance, which was nearer the mark, but somewhat vague. Resonance in the form of resonance with the fundamental frequency is fortunately exceedingly rare. In its minor varieties it is, of course, common, but it is well to remember that all abnormal potentials are not due to resonance. At all events, large disturbances of potential may, on polyphase systems, result from so simple a thing as a ground, and when these are averted their serious secondary effects are eliminated also. It therefore is of no small importance to understand the conditions under which abnormal potentials are liable to be encountered.

It is certain at least that some unpleasant contingencies may be escaped by so simple a device as grounding the neutral conductor in a three-phase system. The effect of such grounding is to give a stable relation between the working voltages involved so far as accidental rise of potential is concerned. Once grounded, the neutral holds at earth potential and one knows exactly what he is dealing with. Of course, a low-resistance ground on the neutral means the possibility of a ferocious short-circuit if there should occur a bad ground on one of the phase wires. On aerial circuits this possibility may sometimes outweigh the advantage to be gained by a grounded neutral, but on underground circuits where any sort of an active ground is likely to put a cable out of commission, the severity of a short-circuit is of small account compared with an increased chance of averting one entirely. It would be interesting to figure out all the various sorts of abnormal potentials that can result from the grounding of lines and apparatus, but it would be a formidable task, and Mr. Eastman should certainly be heartily thanked for bringing to notice a single important case. Obviously, the same conditions which he discusses may exist in the case of secondary mains, causing serious danger of breakdowns in inside fixtures and connections, and the same remedy will prove effective. It is the old question of

grounding the neutral in a three-wire system over again. So far as alternating distributions are concerned, there can be but one answer on the score merely of safety. A grounded secondary system is so essential to safety that it may perhaps be unnecessary to recommend it on other grounds. The best evidence of the success of the policy of grounding the primary neutral is the comparative immunity of the great Chicago system from troubles which have not infrequently been serious elsewhere.

ALTERNATING-CURRENT WAVE FORMS.

At the annual meeting of the American Institute of Electrical Engineers, an interesting paper was presented by Mr. G. H. Rowe on the variations of wave form of e.m.f. on a long-distance transmission system. The system was that of the Standard Electric Company in California, extending from the power house in the hills at Electra to San Francisco, 153 miles away, with taps at a number of stations en route, and with shorter parallel lines and branches. The system was supplied with power at Electra by a plurality of Stanley inductor three-phase, 2-kilovolt, 60-cycle generators in parallel. The e.m.f. was supplied not only by these machines, but also by a number of synchronous motors operating at various places on the system. The voltage on the long-distance lines was in the neighborhood of 40 kilovolts. A Blondel oscillograph was arranged to take photographic oscillograms of the voltage on the system, at successive intervals of about half an hour, for ten or twelve hours together. The oscillograph records were not taken simultaneously over the system, or on the same day at the different stations. The oscillograph seems to have been sent from station to station, and to have been used at different dates, during a period of ten weeks. The oscillograms were taken at the Electra power house and also at San José, Stanford and San Francisco, three stations near the distant end of the system. An additional three-phase—two-phase transformer was in circuit at Stanford, which may have had some special influence there. Omitting Stanford, the wave forms at San José, 113 miles from Electra, and at San Francisco, 153 miles from Electra, fairly resemble each other; so that the discussion is advantageously narrowed, without much loss of generality, by considering only the e.m.f. waves at Electra, the generating end, and at San Francisco, the extreme terminal of the system.

Although the oscillograms were not taken on the same day, yet the evidence favors the belief that there exists a considerable difference in wave form between these two ends of the system at certain times of the day, particularly during the times of heavier load. The e.m.f. waves at Electra may be described as being approximations to sine waves, with a hump or dissymmetry, sometimes on one side of the maximum and sometimes on the other. At San Francisco, the e.m.f. wave is shown to have varied from a nearly sinusoidal form, at 1:30 A.M., when there may have been relatively little load, to almost a double-peaked wave at 6:20 P.M., when the local load may have been relatively heavy. Assuming, however, that the oscillograms, actually taken on different days, are fairly indicative of what occurred simultaneously at the ends of the system on either occasion, it would seem that a distortion in e.m.f. occurred at the distant end of the system, which might almost amount to the production of a double-peaked wave, or a camel-backed wave; while at the same time a slight dissymmetry occurred in the dromedary-backed wave at the generating end. In other words, it seems possible to have dromedary waves of e.m.f. at the generating end of an extended transmission system, and to have camel waves, at the same time, at the other end of the system.

The analysis of the waves, as given in the paper, indicate 10 per cent. harmonics of triple-frequency, and 8 per cent. harmonics of quintuple frequency. Such magnitudes of harmonics are readily capable of producing either camel waves or sharply-peaked dromedary waves, according to their respective phase displacements relatively to the fundamental. It seems evident that if the load on the system were simply incandescent lighting—supplied through transformers—that is to say, if there were no motors connected with the system, the e.m.f. wave form would be substantially the same all over the system, for any reasonable approximation to a sine wave delivered by the alternator. A very kinky wave at the generator, bristling with harmonics, might set up resonant effects at the distant end, with some harmonics, while other less favored harmonics might be smoothed out; but a sine wave at the sending end would establish a sine wave to the last lamp on the system, through the last transformer, except for the small influence of drop of pressure in conductors. The current waves, however, might be very much distorted at light loads, owing to hysteresis in the transformers. At full load this disturbance would be reduced. The variations in current wave form between generator and distant ends would tend to be more marked than the variations in the e.m.f. waves, owing to the influence of charging currents. With capacities at work current waves are always more liable to vary than e.m.f. waves from a single source.

Every motor, and particularly every synchronous motor, connected with a system, is virtually a new generator with its own e.m.f. waves and ripples, added to the system. If the system of transmission conductors had no appreciable resistance, the e.m.f. wave would be the same all over the system. The presence of distributed resistance, inductance and capacity in the transmission lines favors the existence of local ripples due to the various separate generators, whether those generators are supplying power in bulk or are absorbing power in bulk. It is common to find a synchronous motor under load absorbing a large amount of power from the system at its fundamental frequency of 60 cycles per second, and yet generating, and delivering in return, a small amount of power to the system at harmonic frequencies, such as 180 or 300 cycles per second. It seems that this Institute paper contains valuable evidence as to the influence of motor e.m.f's in locally modifying the voltage wave form in a transmission system containing considerable distributed resistance and capacity, as well as some inductance.

ALTERNATING-CURRENT WAVE-FORM ANALYSIS.

In fitting sequel to the preceding topic is an article in this issue on page 1023, by Prof. S. M. Kintner, giving the details of one of the most popular methods of harmonic analysis, or the decomposition of an irregular wave form into its component fundamental sine wave and multiple frequency sine ripples. There are a number of methods of effecting such analysis, and there are also, in fact, several kinds of machines for effecting the analysis mechanically. Prof. Kintner supplies a number of convenient tables, of three-digit accuracy, for effecting the analysis up to the seventeenth frequency harmonic inclusive. He suggests that these can be kept on manifolded or mimiographed forms, with the blank columns ready for their figures. A yet simpler equivalent plan would, of course, be to retain the tables on single columns of paper, or celluloid, for use in juxtaposition with the sheets used in computation, so that one and the same column might serve for an indefinite number of successive analyses. It seems likely that the directions and tables given in the article may be useful to many engineers who may have wave forms they wish to analyze and yet have no mechanical analyzers, such machines being rare and expensive.

Cost of Steam Electrical Generating Plants.

At the recent Washington meeting of the American Cotton Manufacturers' Association, Prof. R. C. Carpenter, of Cornell University, presented a paper entitled "The Cost of Power," from which we extract the portion giving data as to the cost of steam plants.

Table I gives current prices on the basis of a 1,000-hp plant, of various types of steam boilers. The tables following give, on the same basis, the cost of steam engines and electrical generators, together with data as to depreciation, etc.

TABLE I.—COST PER HORSE-POWER OF 1,000-HP BOILER PLANT.

Kind of boiler.	Price per B. H. P. erected.	Depreciation. Per cent.	Cost of brick work.	Total cost of boiler plant and building.	Annual charges, interest and depreciation.
A Horizontal Water Tube Forged Steel Headers	$14.00	5	$2.00	$24.25	$2.42
B Horizontal Water Tube Cast Steel Headers	13.00	8	2.50	23.25	2.59
C Horizontal Water Tube Cast Iron Headers	12.00	10	2.50	22.25	2.72
D Horizontal Water Tube Flat Stayed Head	12.00	10	2.50	22.25	2.82
E Horizontal Water Tube Curved Steel Tubes	9.00	15	3.00	19.75	2.91
F Vertical Water Tube Straight Steel Tubes	9.00	12	3.00	19.75	2.43
G Horizontal Fire Tube Plain Tubular	9.00	15	4.00	18.75	2.46
H Vertical Fire Tube	6.50	20	1.50	16.75	2.64

TABLE II.—COST PER HORSE-POWER OF 1,000-HP ENGINE PLANT.

Kind of engine.	No. of cylinders.	Price per H. P.	Price of condensers.	Price of piping and foundations.	Total cost per engine horse-power.
A Simple Slide Valve, Non-cond.	1	$5.00	....	$5.00	$10.00
B Comp. Slide Valve, Non-cond.	2	8.00	....	7.00	15.00
C Comp. Slide Valve, Cond.	2	8.00	$2.00	8.00	18.00
D Simple Corliss, Non-cond.	1	8.00	....	6.50	14.50
E Compound Corliss, Cond.	2	12.00	2.00	7.00	27.00
F Triple Corliss, Cond.	3	16.00	2.00	7.00	25.00
Electric Generator for D, E and F.		12.00	....	....	....
Steam Turbine with Elec. Generator		30.00	3.00	5.00	38.00

TABLE III.—TOTAL COST OF 1,000-HP PLANT.

Kind of Engine.	Total cost of engines and boilers. F type.	Annual cost of both engines and boilers dep. & in.	Tons of coal per year for one engine H.P., 3000 H.P.	Lubricants.	Labor engine and boiler.	Total cost of power, coal, at $2.00 per ton. Per engine H.P. 1 year.
A Simple Slide Valve, Non-cond.	$29.75	$4.03	6,750	$1.02	$5.00	$23.53
B Comp. Slide Valve, Non-cond.	31.50	4.38	5,660	1.25	4.50	21.45
C Comp. Slide Calve, Cond.	29.80	4.26	4,050	1.25	3.80	17.41
D Simple Corliss, Non-cond.	32.25	3.84	6,075	1.00	4.70	21.00
E Comp. Corliss, Cond.	30.87	3.76	3,375	1.25	3.50	16.25
F Triple Corliss, Comp.	34.25	4.28	3,110	1.50	4.00	16.00
Elec. Gen. for D, E or F.						
St'm Turb. with Elec. Gen. C.	47.87	5.91	3,375	.50	3.50	16.45

TABLE IV.—DEPRECIATION AND OTHER ENGINE PLANT DATA.

Kind of Engine.	Depreciation. Per cent.	Steam per H. P. Ordinary engine.	Steam per H. P. Best record.	Boiler H. P. required per 1000 engine H. P.	Annual charges dep. and int., engine only.
A Simple Slide Valve, Non-cond.	15	33	30	1,000	$1.60
B Compound Slide Valve, Non-cond.	15	25	22	840	2.20
C Compound Slide Valve, Cond.	15	16	14	600	2.80
D Simple Corliss, Non-cond.	10	30	27	900	1.65
E Compound Corliss, Cond.	10	15	12	500	2.55
F Triple Corliss, Cond.	10	14	10	466	3.15
Electric Generator for D, E or F.	10				1.80
Steam Turbine with Elec. Generator	10	15		500	4.70

The final results in Table III show the total cost of power per year, including labor, lubricants and coal at $2 per ton. The cost of steam power for several classes of machinery are taken into consideration as varying from $16 per year with the compound Corliss engine, to $24 per year when the simple slide-valve non-condensing engine is used. The table shows that best results are obtained commercially with the compound Corliss engine, although the steam turbine with electric generator is a close second when the results are based upon the cost per engine horse-power per year.

Interest is assumed at 5 per cent., and the cost of buildings not included. In calculating coal it has been assumed that one boiler horse-power required 4.5 pounds per hour, giving an evaporation of 6.66 pounds of water per pound of coal. In computing labor it is assuming that one man is needed in the boiler house for each 200 boiler hp and that the cost in engine room is $2 per hp-year.

Economizers are not considered. The present cost, allowing 5 sq. ft. of surface per horse-power, is about $6 per hp erected. To obtain the total cost, there should be added for feed pumps, heaters and boiler house piping $1.25; for brick chimney $3.50; for boiler house $4; except for G and H add $5. Mechanical stokers are not considered. The present cost of these is $3.50 to $4.50 per boiler hp. One year is assumed to include 3,000 hours. No charge is made for coal used in banking fires.

Census Report on U. S. Telegraph Systems.

The Director of the Census has issued a preliminary report on the commercial telegraph systems of the United States for the year ending December 31, 1902. The report includes only commercial telegraph companies owned and operated within the United States, which were in operation during any portion of the year, no statistics being given for foreign telegraph companies operating in the United States.

Number of companies	21
Common stock: (1)	
Authorized, par value	$104,383,075
Issued, par value	99,870,225
Gross income	37,552,450
Total expense	28,490,219
Dividends and interest on bonds	6,084,919
Net surplus	2,977,312
Miles of wire operated	1,248,602
Number of messages sent during 1902	90,844,789
Number of telegraph offices	27,352
Batteries in offices:	
Primary—Number of cells	634,491
Storage—Number of cells	19,639

(1) Exclusive of the capitalization of the Postal-Telegraph Cable Company, which was reported as $100,000.

The final report will contain an analysis of the above totals and present statistics for other phases of the industry.

Anniversary of the Telegraph.

The sixtieth anniversary of the sending of the first telegraph message (from Baltimore to Washington) was celebrated by the Postal Telegraph Company at its building in New York City, on May 24. This date also was the tenth anniversary of the opening of the company's building at 253 Broadway. In commemoration of these two events Mr. Clarence H. Mackay, president of the Postal Company, entertained at dinner at the Hardware Club the company's general and assistant superintendents from all sections of the country, including California and Texas. There were 100 at the dinner, the other guests being the officers of the company, including Col. A. B. Chandler, chairman of the directors; George G. Ward, general manager of the Commercial Cable Company; Charles R. Hosmer, vice-president of the Commercial Cable Company; W. H. Baker, general manager of the Postal Telegraph Cable Company; E. C. Bradley and C. C. Adams, vice-presidents; E. C. Platt, treasurer; Ford Huntington, treasurer of the New York Telephone Company.

President Mackay welcomed his guests in a speech in which he said that Prof. Morse lit the torch which now flashes the sparks of intelligence, progress and civilization over the continents and under the seas.

Speeches were also made by Col. A. B. Chandler, Vice-President George G. Ward, of the Commercial Cable Company, and Vice-President Baker, of the Postal Telegraph Company.

Handsome menus were presented as souvenirs. The cover had a picture of the Postal Telegraph Building on the front and the Commercial Cable Building on the back. Inside was a picture of Prof. Morse and the playbill of "The County Chairman," which the party saw on Monday night as the guests of Mr. Mackay.

The Largest Electric Water Power Station in New Hampshire.—I.

MOSES G. FARMER said that Garvin's Falls would one day supply light and power in Manchester, N. H., fourteen miles distant, when he was in that city many years ago. This prophecy has now come true. During 1902 an electric station was built at Garvin's Falls, and energy from the falling water began to be transmitted to Manchester at about 12,000 volts pressure, as described in the ELECTRICAL WORLD AND ENGINEER of January 17, 1903. At that time the capacity of the electric station was 1,300 kw, and the water was made available at the station by a previously existing dam and canal.

This dam is decades, and the canal perhaps a century, old. In that portion of its bed opposite to the canal, the Merrimac River passes over a series of rapids or low falls, and the old canal appears to have been built at first as an aid to navigation between Concord, New Hampshire and Boston. In 1793 a charter was granted for the construction of a canal between the Charles River and Lowell, on the Merrimac River. About the same time the Bow Lake and Canal Company secured a charter with the right to perfect navigation south of Concord on the Merrimac River. This stream passes over a number of falls and rapids between Concord and Lowell and the remains of an old canal can be traced at a number of such points along the river. Just when the canal through which boats passed around Garvin's Falls came into use cannot now be stated, but Hayward's *New England Gazetteer,* published by John Hayward at Boston, in 1839, mentions the canal as an important waterway for boats coming south from Concord.

The railways having put an end to water traffic on the Merrimac, attention was turned to Garvin's Falls as a source of power, and a stone dam was completed there near the upper end of the old canal, on September 5, 1859. The final builder of this dam, being in a hurry to complete it, dumped a large amount of loose rock in to form the central portion, after the builder of the end sections had been called to Washington to superintend work on a new government building there. As might have been expected, the dam failed in the freshets of the following year, about 200 ft. of the central portion going out on March 5, 1860. The dam remained in this partly

FIG. 1.—OLD DAM AND CANAL, GARVIN'S FALLS.

ruined condition for nearly a score of years, or until 1879, when its owners filled up the central gap with a timber crib and stone section just in time to prevent the lapse of their flowage rights.

At the time when a location was being sought for some of the large cotton mills now at Lowell, the site at Garvin's Falls was considered, but finally rejected. Thus the small tower of Bow, where the falls are located, escaped the fate of being a large city. From the rebuilding of the dam in 1879 down to about 1890 the water power at Garvin's Falls appears to have been used to some extent and during a portion of the time for local manufacturing purposes. Some time after the latter date an electric lighting station of small capacity was built there for comparatively nearby service, and this lighting plant remained until after the property passed into the hands of the Manchester Traction, Light & Power Company, near the close of the century. From all this it appears that although these falls had been close to places of considerable population for a hundred years, and a dam and canal had been maintained for power purposes during forty years, yet most of the energy of the water had run to waste during these long periods. It remained for electrical transmission, answering the demands of the largest city in the State, to bring Garvin's Falls effectively into the service of men.

Shortly after the purchase of the Garvin's Falls property by the Manchester company, the new electric station of 1,300-kw capacity, above named, was built, and the transmission at 12,000 volts to that city begun. This new station relied for power on the patched dam of 1859, and on the transportation canal that ran back into the eighteenth century for its origin. Though the Manchester company had

FIG. 2.—OLD AND NEW CANAL IN USE TOGETHER, GARVIN'S FALLS.

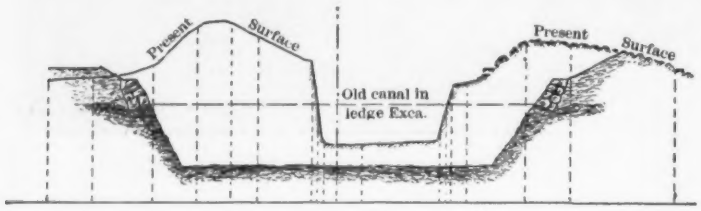
the right to utilize the entire flow of the Merrimac it was impossible to do so, because the ancient canal originally dug for small boats could not carry the whole river. Furthermore, the composite dam was of uncertain strength. The plan of the Manchester company was, therefore, from the start to build a new dam and dig a canal that would carry all the available water at times of moderate flow. Meantime, as the demands for light and power in Manchester were pressing, an incomplete station was built at the falls and as much generating equipment was installed as the water coming down the old canal would operate. For half a year work has been under way on the new dam and canal, and on the extension of the power house. This work has now reached a stage that gives promise of the early delivery in Manchester of all the power that a 28-ft. fall in the Merrimac will yield.

The construction now under way at Garvin's Falls contemplates an ultimate station capacity of 3,900 kw or 5,200 hp in electric generators. This capacity is to be made up of six three-phase, 60-cycle alternators, each rated at 650 kw and 12,000 volts. Three 39-in. turbine wheels mounted on the same horizontal shaft are direct-connected to each generator and drive it at 180 r.p.m. The rating of each group of three wheels is 1,000 hp. As the station at Garvin's Falls now stands, with 1,300-kw capacity in electric generators, it is the largest electric water power plant in New Hampshire. When the extensions now under way are completed and the station capacity is raised to 3,900 kw, it seems improbable that any electric water power plant in the State will equal it for at least many years to come. This conclusion is supported by the fact that the Merrimac is much the largest river in New Hampshire, and that the fall at Garvin is greater that that at any other point on the river in that State, save the one at Manchester, which is utilized by a great manufacturing corporation located there.

The Merrimac is not a great river, being only 110 miles long from its head, at Franklin, N. H., to its mouth at Newburyport, Mass., neither is its elevation exceptional, for the head waters at Franklin are only 269 ft. above sea level. Nevertheless, this comparatively small river probably turns more spindles than any other stream in the United States or even in the world. This is due to the fact that three of the four largest powers on the river, those at Manchester, Lowell and Lawrence, are mainly devoted to the manufacture of cotton goods. Considering its length, the drainage area of the Merrimac is exceptional, being 4,864 square miles. At Lawrence, 28 miles from the mouth of the river, the drainage area is 4,553 square miles, and the mean annual discharge of water from 1890 to 1897, inclusive, ranged between 4,850 and 9,373 ft. per second. Above

Garvin's Falls, which is 83 miles from the mouth of the Merrimac, the drainage area is 2,400 square miles, and it is estimated that the head of 28 ft. there will yield at least 5,000 hp during nine months of each year. During the great freshet of March 2, 1896, the largest in the history of the river, it is estimated that the discharge at Garvin's Falls rose to 72,000 cu. ft. per second. At Lawrence the fall of the Merrimac is 29 ft., and at Manchester it is 52 ft., and these are the only other two points on the river where the height of the fall at Garvin's is approached.

The old dam at Garvin's Falls is located about 1,240 ft. up stream from the power station, and water formerly came down to the station through the old canal of that length. Between abutments the old dam, built in 1859, and partially rebuilt in 1879, has a length of 454 ft. The old canal is a rough excavation of irregular cross section, and has an overflow wall of timber and stone for a part of its length on the side next to the river. The new dam is being built across the river at a point approximately 500 ft. up stream from the power station, and something more than 700 ft. below the old dam. In length the new dam is about 550 ft. between the abutments and these latter, together with their core walls and the head gate wall, extend up into the banks about 160 ft. on the canal side and 80 ft. on the opposite side of the river, beyond the central portion of the dam. On the right-hand side of the river, at one end of the new dam, the new canal begins and in its course to the power house it



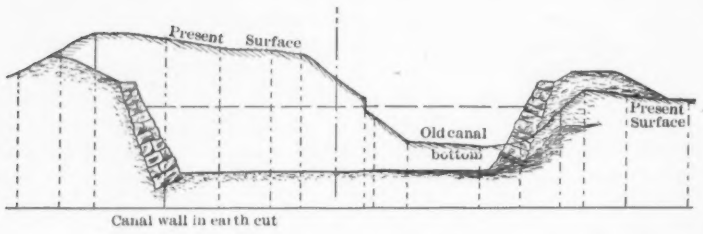


FIG. 3.—CANAL PROFILES.

overlaps substantially the entire site of the lower 500 ft. in the length of the old canal. The new site selected for the dam not only afforded a natural rock foundation with comparatively little excavation, but also shortened the required length of canal by more than 700 ft.

Of the total length of about 550 ft. in the central portion of the dam, 70 ft. at the left-hand end has a crest 2 ft. above that of the remainder in elevation. For its entire length the dam rests on the natural ledge in the bed and banks of the river. In general outline the dam is straight and its height above the bedrock varies from about 10 to as much as 25 ft. between the elevations of heel and crest. A notable feature of the dam is its width up and down stream, which amounts to as much as 31 ft. from heel to toe in the part that is 25 ft. in elevation from heel to crest. The portion of the dam between the abutments is of stone masonry laid in mortar of Portland cement and sand. Ashlar masonry is used on the crest and down-stream face of the dam, and rubble masonry for its up-stream face and core. Of that portion of the dam between the abutments three sections have been completed, one section adjoining each abutment and one about mid stream, and if the weather is favorable it is expected that the entire dam will be completed during the winter. Both of the dam abutments, including the head gate wall at the entrance to the canal on the right-hand bank, are practically finished. The right and left bank abutments are formed of concrete and faced with ashlar masonry, and the head gate walls are built entirely of concrete.

When the new canal is considered, the importance of the change made in the water power development at Garvin's Falls becomes evident. The striking feature of the new canal is its great increase in area of cross-section over that of the old. It is hard to state accurately just what is the cross-section of the old canal, since this varies materially in the course of its length, but it may be put at approximately 264 sq. ft. for at least a part of its course, up to the

FIG. 4.—HEAD GATES, NEW CANAL, GARVIN'S FALLS.

top of its banks. Compared with this, the area of cross-section for the new canal to the top of its banks is 1,260 sq. ft. at the entrance to the forebay. Up to its flow line the canal has a cross-section of 750 sq. ft. before it widens into the forebay. The new canal has been excavated partly in earth and partly in ledge, and some filling has been necessary along its banks. In all cases where the canal wall or any part of it is in earth, this wall is of concrete or stone masonry. Before entering the forebay the canal at its flow line, which corresponds in elevation with the top of the dam in its mid-stream section, has a width of 74 ft., and this flow line is 13 ft. above the canal floor. In its course of about 500 ft. between the head gates and the forebay the level of the canal floor drops one foot.

The floor of the forebay gradually drops to a level four feet below that of the canal at the point of entry. This gives the water in the forebay, when just up to the level of the top of the dam at its

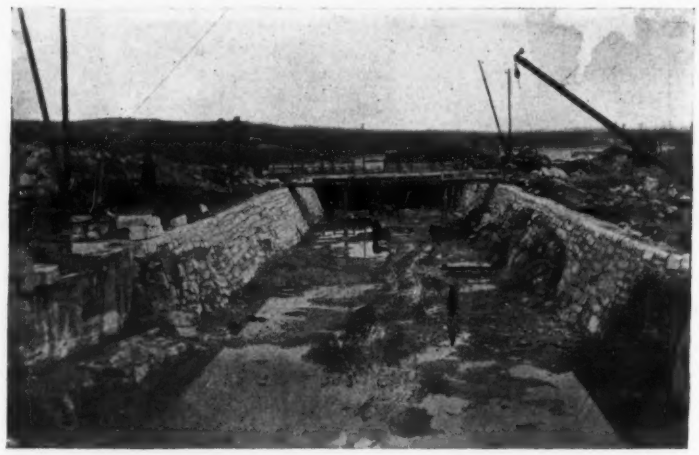


FIG. 5.—CANAL FROM HEAD GATES, GARVIN'S FALLS.

middle section, a depth of 17 ft. At the river side of the forebay is an overflow wall 90 ft. long with a crest that is 2 ft. above that of the river section of the dam. At the rack the width of the forebay is increased to 134.5 ft., and 80 ft. of this rack length represents the new addition. In vertical height the rack is 20 ft., and its top is 3 ft. above the crest of the river section of the dam. In the forebay wall near the river end of the rack are the waste and flush gates. The entire floor of the forebay was excavated in the ledge of the river bank.

The head wall of the forebay forms also one side of the wheel room at the power station. This station thus sets directly across the lower end of the canal, and is connected with the river by a short tail race. On the top of this head wall of the forebay, which is of

stone masonry and rises to an elevation 8.5 ft. above the crest of the river section of the dam, there is a pent house containing electric motors that operate the gates of the several wheels. When completed the power station will have an outside width including the head forebay wall of 67 ft., and an outside length of 149.75 ft., at the foundation level. Of this total length that part of the station built in 1901 forms 65.5 ft. The wheel room from the outside of the head wall of the forebay to the wall that separates the wheel and generator rooms is 33.5 ft. wide, has less elevation than the remainder of the power station, and is covered by a nearly flat roof. Inside of the generator room the width is 30 ft. and the length about 146 ft. Above the stone foundations the station walls are of brick and the parallel walls on the two longer sides are each 24 in. thick to an elevation of 20 ft. above the floor of the generator room, at which elevation their thickness shrinks to 9 in., giving a shelf 15 in. wide to support the traveling crane. Beneath the generator room there is a stone foundation resting on bedrock and consisting of arches, and this foundation is pierced by seven arched openings, which connect an open space beneath the entire wheel room with the tail race.

The floor of the wheel room is of spruce plank laid on steel I-beams that rest on the head wall of the forebay at one end, and on the arches beneath the generator room at the other end. These I-beams also support the wheel cases, which are hung between them. Seven steel wheel cases pierce the forebay wall and extend into the wheel room. Each of six of these cases is 12 ft. in diameter and contains three 39-in. horizontal turbine wheels. The seventh case is 5 ft. in diameter and contains two turbines of 12 in. diameter each. From

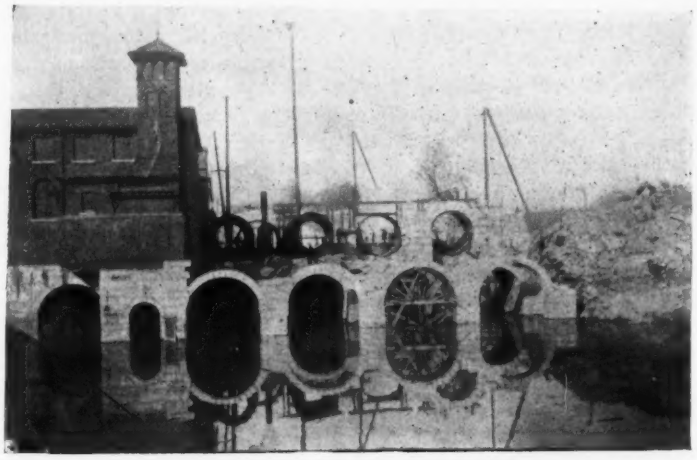


FIG. 6.—NEW FOUNDATIONS FOR ADDITION TO GARVIN'S FALLS POWER STATION.

each wheel case two draft tubes extend down to a level below that of the tail water. From each set of wheels the horizontal shaft extends through a water-tight bearing set in the wall that separates the wheel room from the generator room, and is direct-coupled to that of a generator or exciter. The center of the shaft of each set of main wheels and of their generator is 10.5 ft. below the crest of the dam at its river section, and 17.5 ft. above the ordinary level of the tail water.

In the generator room the concrete floor is supported by the stone arches beneath, and rests in part on I-beams that span the spaces between them. The floor is finished with a layer of Portland cement mortar 2 in. thick. As the floor level in the generator room is 15 ft. below the crest of the dam at its river section, and 5.24 ft. below the level reached by the back water in the great freshet of March 2, 1896, the highest on record, both the floor and the walls were made water-tight up to a level 2 ft. higher than that reached by the back water during the freshet just named. With this construction the power station may continue in operation when high water backs up about its outside walls and in the wheel room to an elevation more than 7 ft. above that of the floor in the generator room. As the entrance to the station, at the end more distant from the river, has an elevation as great as that of the dam crest, and about 10 ft. above the freshet level no water can enter there.

Beneath each of the 650-kw alternators in the generator room there is a pit 12 ft. long, 6 ft. 2 in. wide and 2.5 ft. deep beneath the floor level. Each of these pits is connected by iron pipe with a drain tank set beneath the floor level, and water is removed from this tank by means of a small centrifugal pump driven by a motor. From each or the pits beneath the main generators and also from each of the two exciters, conduits are laid to the switchboard bay. This bay is located about midway on that side of the generator room opposite to the wheel room. Exclusive of the switchboard bay the total width of the generator room is only 30 ft., and of this width the row of generators takes up 17.5 ft., leaving only 12.5 ft. between

FIG. 7.—LAYING FOUNDATIONS FOR ADDITION TO POWER HOUSE.

the outer end of a generator bearing and the wall. The switchboard bay juts out on the tail race side of the generator room with a length of 33 ft. and a depth of 6.5 ft., above the foundations. Inside the switchboard bay measures 7.5 ft. wide and 26 ft. long at the floor level, and the lowest point on the inside of its slanting roof is 16.5 ft. above the floor. The switchboard sets in this bay so that its face is nearly in line with the inside surface of the main wall of the generator room, and this location leaves ample room for access to the rear of the board, which is reached through a door at one end. Beneath the switchboard and running its entire length is a trench in the concrete floor 10 in. wide and 12 in. deep, where the conduits carrying cables from the generators and exciters terminate. In the side wall of the switchboard bay at an elevation above the top of the board a row of slate slabs are set in the brickwork, and these slabs are pierced by circular openings through which the bare conductors pass that transmit the energy of the water power plant to the sub-station in Manchester, 14 miles away.

As matters stood at Garvin's Falls early in 1903, before construc-

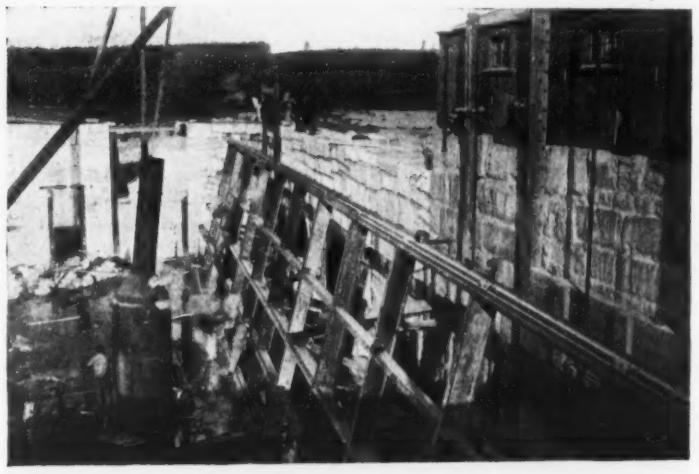


FIG. 8—RACK AND FOUNDATION FOR ADDITION TO GARVIN'S FALLS POWER STATION.

tion on the extension of the power plant was started, it was necessary to discontinue the operation of the station altogether, while the new canal and the foundation for the addition to the station were being built. The 1,300 kw of generator capacity in the incomplete station could be shut down with the least loss during the summer months, and the general contract for the new dam, canal and extension of the power station was accordingly closed on June 5, 1903, with the provision that the new canal, station foundations and the

deepening of the tail race were to be first completed. This plan has been carried out, water was let into the new canal in November of the present year, and the older portion of the power station with its two 650-kw generators is now in regular operation. It remains to complete the new dam and the addition to the station above the foundations, and to remove a portion at least of the old dam of 1859. This old dam and the upper section of the old canal are still in use to divert and deliver water to the new canal. The upper 700 ft. in the length of the old canal brings water down to the head gates of the new canal, and will continue to do so until the new dam is completed. By this use of the old canal it is possible to maintain a dry river bed for work on the new dam, while the new canal is in use. The work of construction can now go on without interfering with the operation of the older part of the power station, and it is expected that the entire development will be completed during the first half of 1904.

The Manchester Traction, Light & Power Company, the owner of the electric light, power and traction systems in that city, owns also the entire water power rights and developments at Garvin's Falls. Hollis French and Allen Hubbard, consulting engineers, of Boston, are the engineers for the Manchester company on all of the work above described, being represented at the work by Mr. George G. Shedd, resident engineer. The general contractors for the work are Holbrook, Cabot and Rollins, and their superintendent at Garvin's Falls is Mr. J. B. Haviland. The other contractors on the plant are, for steel work, the Boston Bridge Works; for the station building, Waymire & Penniman; for the electrical machinery, the General Electric Company; for the switchboard, S. B. Condit, Jr. & Co.; for the water wheels, the Rodney Hunt Machine Company.

Especial thanks are due to Mr. J. Brodie Smith, general manager of the Manchester Traction, Light & Power Company, and to the engineers, Hollis French and Allen Hubbard, for aid in the collection of the above facts.

Rise of Electric Lighting in New England.

By Alton D. Adams.

BEGINNING OF ELECTRICAL SUPPLY.

CHARLES FRANCIS BRUSH exhibited a four-lamp arc dynamo at the Mechanics' Fair in Boston during October, 1878. On November 9, after the Fair, this dynamo and lamps began to operate in a building occupied by the Continental Clothing House, at the corner of Howard and Washington Streets. This was the first electric light plant installed for regular service in Boston, and probably in New England.

Much light is thrown on the state of the art at that time by the construction of this dynamo and lamps, which Mr. Brush thought of sufficient importance to warrant their exhibition by him in person. The armature core was a cast-iron ring with wide slots to receive the coils in radial directions on its two sides. There were eight of these slots on each side of the ring, and it was wound eight coils or bobbins as they were called. Diametrically opposite coils were connected in series, and the four pairs of coils thus formed had the two free ends of each brought out to a two-part commutator ring. Each of the four commutator rings was electrically independent of the others, and from each ring two bare No. 6 wires were carried to a single arc lamp. Independent commutators were necessary on this dynamo because the arc lamps had no automatic cut-outs, and when the carbons in any lamp had burned out its circuit was completed through only the fine shunt winding. Bare square carbon rods were used in these lamps, and their cost was 25 cents each.

The electric arc thus brought to public attention in Boston was soon seen at other points in New England. Isolated plants naturally come first, and then central stations for general lighting. One of the earliest, if ot the first public lighting system in New England, was that using the United States series dynamo and arc lamps in New Haven, Conn., which began to operate on July 4, 1881. The next year was one of much activity in the promotion of lighting from central stations, and equipments were installed for this service at Portland, Me.; Manchester, N. H., and Lowell, Lawrence, Lynn, Salem, Taunton and Springfield, Mass., in 1882. At Manchesser the first plant comprised 10 Weston arc dynamos with a capacity of ten lamps each, and was operated with rented power in one of the mills of the Amoskeag Maufacturing Company.

The Portland Electric Light Company had one small arc dynamo driven by a simple engine, and began to supply light in that city during February, 1882. In Lowell the first public lighting system was preceded by a plant of a Brush dynamo and ten arc lamps in the clothing store of Putnam & Son, on Central Street, which was started in operation about May 1, 1882. Later in the same year a company was formed for general lighting service, and three Weston arc dynamos with a capacity of ten lamps each were installed in the basement of Davis & Sargent's mill for this purpose. Circuits from these dynamos were run along Middlesex and Central Streets, where 30 arc lamps were hung, and the plant went into operation on the day before Christmas, in the year just named. The Middlesex Electric Light Company was formed and installed a public system of arc lighting with Thomson-Houston dynamos and lamps at Lowell in 1883, and this company was soon consolidated with the one that had preceded it. Sometime after this consolidation the capacity of the lighting system was increased by the addition of a 600-lamp, 110-volt Thomson-Houston dynamo for incandescent service.

Lawrence was the site of the first Edison three-wire system in the State, and probably in New England, the company for the installation of the Edison system there having been formed in 1882. In the same year the Lawrence Electric Light Company was formed for the operation of the Thomson-Houston system of arc lighting there, and both of the companies began their service before the end of the year. Some years later both of the electric companies sold their systems to the Lawrence Gas Company.

The Salem Electric Lighting Company began operations, in 1882, with the Thomson-Houston arc light apparatus. In the same year the Lynn Electric Lighting Company began service in that city from a Thomson-Houston dynamo that was driven by rented power in a shoe factory on Market Street, nearly opposite the station of the Boston, Revere Beach & Lynn Railway. A little later the plant of the Lynn company was moved to Stewart Street and provided with its own steam plant. In 1888 the gas and electric company at Lynn were consolidated under an act of Legislature. Electric lighting was begun at Springfield, in 1882, by the Blair Manufacturing Company with Thomson-Houston arc dynamos and lamps. The plant thus started was subsequently secured and operated by the Springfield Electric Light Company, and, in 1887, the entire system passed into the hands of the United Electric Light Company.

Every one of the first electric lighting systems just mentioned, with the single exception of the Edison at Lawrence, had been equipped at the start with only arc dynamos and lamps. In the following years incandescent lighting claimed a large share of attention. The Pearl Street Edison station in New York had been started in September, 1882, and was a striking example of what could be done in the multiple operation of incandescent lamps.

In May, 1883, the original Fall River Electric Light Company started its plant of one Thomson-Houston arc dynamo with power rented in a machine shop in that city. October of the same year saw an Edison station equipped in Fall River with its three-wire circuits entirely in underground tubes. In 1896 these two companies were consolidated under the name of th- former. An Edison company was also incorporated for operation in Brockton during 1883, and subsequently absorbed an arc lighting system operated there by another company.

This year of 1883 marks the beginning of electric lighting from central stations in Boston, and two companies then started their plants. One of these plants operated with the Brush arc dynamos and lamps, and its first machines were located in Ham's Iron Works on Portland Street. From this plant the first arc street lamps in Boston were operated. After a few months the dynamos of the Brush system were moved to a station on Lancaster Street, and still later to the well-known Ferdinand Street station. In the same year that the Brush company began operations, the Merchants' Light, Heat & Power Company rented a space in the basement of the Mechanics' Building on Huntington Avenue, and installed a 10-lamp Thomson-Houston arc dynamo driven by a small high-speed engine for general commercial lighting. This plant was soon made larger, and in 1885 was moved to 197 Congress Street.

The Massachusetts Electric Power Company was formed in the year last named, and installed at the Congress Street station of the Merchants' Company the first dynamo ever used in Boston for the distribution of current exclusively to electric motors. This dynamo was of the Daft make and rated at 50 hp and about 110 volts. Steam power was rented from the engine of the Merchants' Company to

operate this Daft dynamo, and it is related that the engineer of this company would watch for the greatest loads on the Daft machine and then take cards from his engine to determine the basis on which the power used was to be computed. The power company operated only motors with their Daft dynamo, as it was thought impracticable at that time to supply both incandescent lamps and motors from the same machine. In this 50-hp, 110-volt Daft dynamo of 1885, with its two-wire circuits to nearby motors, might have been read the prophecy of the great electric motor load in Boston at the present day, but those most interested saw it not.

In 1884 another company, the New England Weston, entered the arc lighting field at Boston with dynamos and lamps of the Weston make. These three arc lighting companies, the Brush, the Merchants' and the Weston, operated in competition until about 1887, and were then consolidated in the Boston Electric Light Company, which was formed for the purpose. In this consolidation there was also included the power company that had started with the Daft dynamo.

During these hard, early years of competition capital did not flow to electrical enterprises as readily as it does now, and some amusing incidents are related of the financial straits to which the companies were sometimes put. Its contract for street lighting gave the Brush Company a degree of opulence not enjoyed by the others, which had to rely solely on their commercial business, and this led to a prodigal rejection of rather long carbon stubs by the trimmers of the street lamps. Knowing of this habit and also of the limited resources of their own employer, the trimmers of the Merchants' Company were wont to go about under the Brush street lamps and gather the rejected carbon stubs for their own use. It is even said that there were times when the operators at the Merchants' station were obliged to go out and buy oil with their own money to prevent shutting down the machinery. This company had a contract with the Hotel Brunswick to supply an arc lamp outside during the evening and also a contract with the Adams House to operate an arc lamp inside during a part of each day. Having only one arc lamp that could be devoted to both of these hotels, the employees of the Merchants' Company were obliged to carry this lamp back and forth every day. Sometimes when a day was darker than usual it required no small degree of strategy to get this lamp to the Brunswick early enough and yet not take it away from the Adams House too soon.

On December 31, 1888, the station bounded by Summer Street, Gilman Place and the water front, which had been built by the Boston Electric Light Company to care for the consolidated business of the earlier companies was started. The station of the Weston Company, on Stanhope Street, was continued in operation as part of the Boston system until 1893, and was then abandoned. The Ferdinand Street station was also continued in operation, and though burned down in 1893 was at once rebuilt. From 1898, when the L Street station was started, to 1902, when the Boston Electric system passed into the hands of the Boston Edison Company, the Ferdinand Street station did duty in the distribution of current from L Street, and was abandoned in the latter year. In 1894 the Boston Electric Light Company equipped its station on Boston Street with apparatus that had been exhibited at the World's Fair in the previous year. After 1898 the energy for the Boston Electric Light system was mainly generated at its last, best and largest station on L Street.

Combination of Independent Telephone Interests.

A number of representatives of independent telephone companies throughout the country arrived in St. Louis May 13 and held two business meetings. It is reported that it is the preliminary to a combination of interests in the near future. There was an executive session in the offices of the Kinloch Telephone Company, and another meeting was held in the afternoon. The entire party went to the World's Fair in the evening and was entertained at the "Tyrolean Alps."

Among the visiting representatives was a delegation from Pittsburg, Pa., whose members are believed to be leading the others in an effort to perfect a combine of the independent companies. The Pittsburg delegation has already visited Cleveland, Ohio; Toledo, Ohio; Grand Rapids, Mich.; Chicago, Ill., and Kansas City, Mo. Before returning to Pittsburg its members will visit Louisville, Ky.; Indianapolis, Ind., Dayton and Columbus, Ohio.

The following attended the executive session: James B. Hoge, of Cleveland, Ohio; J. A. Armstrong, A. L. Tetu and Col. J. D. Powers, of Louisville, Ky.; B. B. Sale, Indianapolis, Ind.; James S. Brailey, Jr., of Toledo, Ohio, director of the Home Telephone Company, of Kansas City, Mo.; J. G. Splane, president, and R. C. Hall, D. P. Reighard, William Flinn, John S. Weller, J. T. Braden, D. R. Williams, J. V. Wibbs, T. T. Misslin, John A. Howard, H. M. Nichols, H. B. Beatty, directors, and S. H. Browne, manager, Pittsburg and Allegheny Telephone Company; A. O. Stromberg, Chicago; C. Marquard Forster, president, W. Roy McCanne, secretary, and W. Linton Reber, general manager, Kinloch Telephone Company, St. Louis, and the following directors: Rolla Wells, Breckenridge Jones, William S. Nolker, E. H. Benoist, W. L. Benoist, Philip Scanlan and M. H. Clapp.

The Nature of Patents and Inventions.

Mr. Samuel G. McMeen delivered recently an address to the engineering student body of Lewis Institute, Chicago, on the above subject. He said that a patent issued by our government is a memorandum of a bargain between the inventor as one individual and the people of the country as another. This bargain is to the effect that because the inventor furnishes to the people a more or less useful product of his brain they in their turn guarantee to pay him for his effort. The payment is not made in a definite sum of money, but in an arrangement whereby he may enjoy for seventeen years all the profits coming from the use of the thing he has produced. Rights to these profits he may sell or rent to others or make such disposition as he likes, but from the time of the making of the bargain the thing belongs to the people. At the end of the seventeen years the inventor has no further claim on his production and it belongs thereafter wholly to the people, having been bought and paid for.

In a sense the price paid by the people is set by the inventor. It may be very large or very small, depending on the excellence of the invention or on the caprice of the people. Examples will come to mind of inventions almost trivial, so far as real usefulness is concerned, but which gave the inventor large financial return. There are other examples of inventions which were epoch-making, but because they were too soon for the minds of the pople, brought no financial return. It may be that if they had been invented later, so that the period of monopoly had coincided with the period of welcome, the reward might have been proportionate to the excellence of the conception.

The industrial greatness of this nation is in large measure due to the existence of good patent law and to the encouragement which has been given to inventors by its operation. The inventive ability of a people lies not alone in its facility in finding ingenious ways of setting things together to achieve results, but also in its wisdom to see clearly industrial and social needs. In the instance of the inventor who produced the cranberry sorter, everyone in the cranberry industry knew the need of sorting so that cranberries for market would contain no soft ones; it required a mental aptitude to see an immediate possibility of invention in the circumstance that when cranberries were spilled down the back steps only the sound ones hopped from step to step, the soft ones stopping early.

It is not true that a patent granted by the United States may be renewed. A reissue is not an arrangement by which an expiring patent may be given new life, but only an arrangement whereby a necessary correction may be accomplished. In other countries there are periods of patent life, which, by proper action, may be extended somewhat as in the case of a copyright in this country, but in each case there is an ultimate time beyond which the term of the patent cannot be extended.

An applicant may not secure a patent in this country if his invention has been in actual public use for two years or more before he makes his application. Interesting questions sometimes arise as to whether the use has been really public or might not have been wholly for the purpose of testing the efficiency of the invention by a continued test. A form of sidewalk which had been in use for two years was held not to vitiate the rights of the applicant because, although distinctly in public use, the excellence of its form could only be proven to the inventor by actual trial and could not be considered to be a final test unless continued for a considerable time. In another instance of an article of wearing apparel distinctly not public in its use, a period of two years was held wholly to vitiate the rights of the applicant because very much less than two years should have sufficed to enable him to decide whether the invention was or was not in a proper form for filing his application.

An Expression for the Torque of a Polyphase Wattmeter.

By F. R. Stowe.

ALTHOUGH the following discussion could apply to any polyphase recording wattmeter, the writer has in mind a standard type of a well-known make.

All recording meters for alternating-current circuits are really induction motors of very small power. The rotor of this meter is an aluminum disc. The stator comprises two sets of windings, each set consisting of two series coils and one potential coil. The potential coils have laminated iron cores, and in series with each, but placed so as not to act on the rotor, is another coil wound to have a high reactance. Each potential coil has a short-circuited secondary for

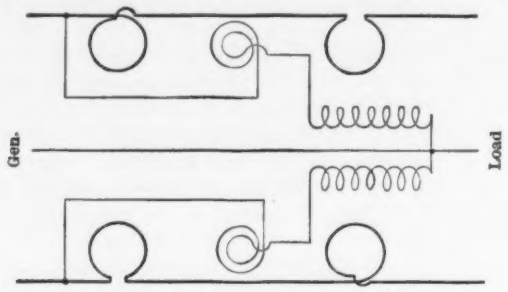


FIG. 1.—METER CONNECTIONS.

the purpose of bringing the lag of the magnetic flux behind the impressed e.m.f. to exactly 90°. By proper adjustment of the resistance through which it is "short-circuited" this can be done.

Fig. 1 shows how the meter is connected to measure the power in a three-phase circuit. It also indicates the direction of winding and the relative position of the coils. Let us take up first the case of a three-phase circuit with unity power factor of which Fig. 2 is the vector diagram. Let I_1 and I_3 be the currents flowing through the series windings and E_{21}, E_{23} be the corresponding e.m.f's. Consider I_1 and E_{21} as in, say, the lower set of coils in Fig. 1. There being no iron in the magnetic circuit of the series coils, the flux, M_1 (see Fig. 3), is in phase with I_1, and the eddy currents, E_{I_1}, induced in the disc are 90° behind I_1. M'_1 is the flux due to E_{I_1}.

In the potential circuit, however, the current, $I_{E_{21}}$, due to the high reactance, lags about 80° behind E_{21} and the effect of hysteresis and the lag coil is to make the flux, $M_{E_{21}}$ 90° behind E_{21}. We thus have the following reactions to consider: Between M_{I_1} and $M'_{E_{21}}$, 150° behind M_{I_1}; and between $M_{E_{21}}$, 60° behind M_{I_1}, and M'_{I_1} 30° behind $M_{E_{21}}$.

The torque produced by the reaction between M_{I_1} and $M'_{E_{21}}$ is positive when their instantaneous values have opposite signs, and negative when these values have the same sign. Thus, it is not uniform throughout a cycle, but varies from a large positive value to a comparatively small negative value. The same is true of the torque produced by $M_{E_{21}}$ and M'_{I_1}. The sum of these two torques, however, is positive and constant, as may be shown as follows:

The torque due to M_{I_1} and $M'_{E_{21}}$ at any instant is

$$T' = -C M_{I_1} \sin \theta M'_{E_{21}} \sin (\theta - 150);$$

that is, the product of their instantaneous values. The minus sign is used because when these values have opposite signs T' is positive. C is a constant depending on the units in which T'_1, M_{I_1} and $M'_{E_{21}}$ are expressed and on the distance between the coils. Or we may write it:

$$T' = C M_{I_1} M'_{E_{21}} \sin \theta \sin (\theta + 30).$$

In the same way we get the torque due to $M_{E_{21}}$ and M'_{I_1}:

$$T'' = -C M_{E_{21}} M_{I_1} \cos \theta \sin (\theta - 60).$$

Then the total torque is:

$$T_1 = T' + T'' = C \{ M_{I_1} M'_{E_{21}} \sin \theta \sin (\theta + 30) - M_{E_{21}} M'_{I_1} \cos \theta \sin (\theta - 60) \}.$$

Let $A = \frac{M'_{I_1}}{M_{I_1}} = \frac{M'_{E_{21}}}{M_{E_{21}}}$, as it depends only upon the frequency and the resistance of the disc. Substituting in the above equation for T_1 values of M'_{I_1} and $M'_{E_{21}}$ in terms of M_{I_1} and $M_{E_{21}}$ and simplifying the sine and cosine terms we get

$$T_1 = C A M_{I_1} M_{E_{21}} \cos 30 = \text{constant}.$$

The above result could have been arrived at in a simpler manner, which follows, but it would not have been so clear that the torque is constant throughout a cycle.

The reaction between two fluxes is proportional to the vector product of their effective values, so we have

$$T' = C \frac{I}{\sqrt{2}} M_{I_1} \frac{I}{\sqrt{2}} M'_{E_{21}} \cos 30°$$

$$T'' = C \frac{I}{\sqrt{2}} M_{E_{21}} \frac{I}{\sqrt{2}} M'_{I_1} \cos 30°,$$

substituting as before $A M_{I_1}$ for M'_{I_1}, and $A M_{E_{21}}$ for $M'_{E_{21}}$, we get

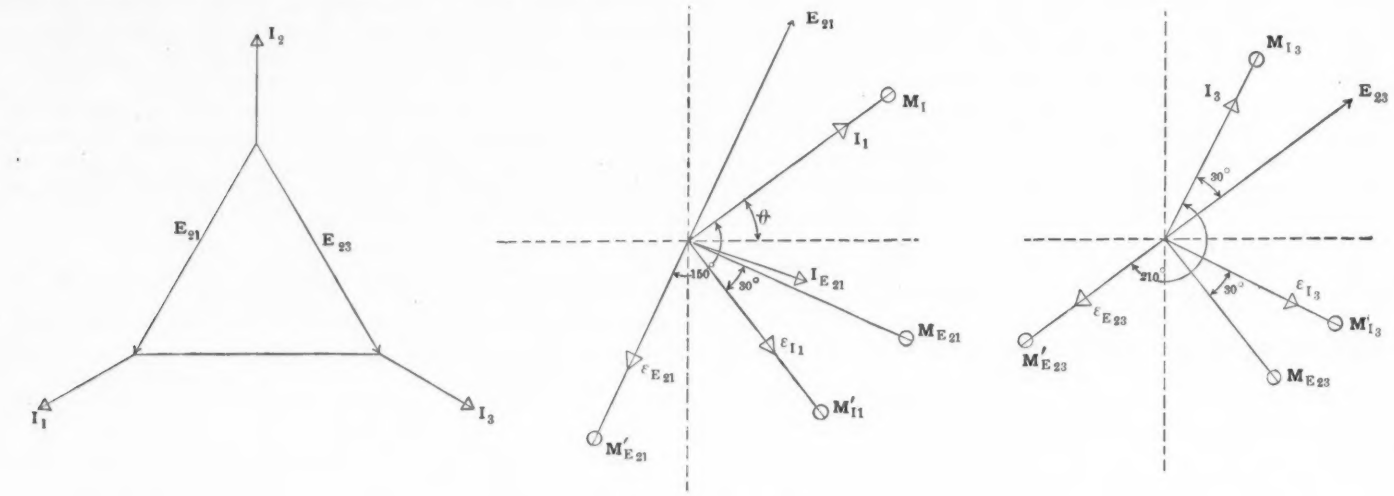
$$T' = \frac{CA}{2} M_{I_1} M_{E_{21}} \cos 30° = T''$$

and $T_1 = C A M_{I_1} M_{E_{21}} \cos 30°$.

In the same manner we get the torque produced by the other set of coils (see Fig. 4):

$$T_3 = C' A' M_{I_3} M_{E_{23}} \cos 30°.$$

If we assume now the current to lag ϕ°, the above expressions



FIGS. 2, 3 AND 4.—CURRENT DIAGRAMS.

would be changed in one respect only, *cos* 30° becoming *cos* (30 + ϕ) and *cos* (30 − ϕ), and we would get as an expression for the total torque,

$$T = C A M_{I_1} M_{E_{21}} \cos (30 + \phi) + C' A' M_{I_3} M_{E_{23}} \cos (30 - \phi),$$

which corresponds exactly to the expression for the power:

$$P = I_1 E_{21} \cos (30 + \phi) + I_3 E_{23} \cos (30 - \phi),$$

showing that T varies as P.

We have neglected in the above discussion the effect of magnetic leakage, and the rotation of the disc, upon T. Tests made on one meter showed a difference of about 2 per cent. between the starting and the running torques.

Alternating-Current Wave Form Analysis.

BY S. M. KINTNER.

WHILE it is quite generally known that the wave forms of current and voltage of alternating-current machinery can be represented by a series of sine waves varying in frequency, phase and amplitude, it is not so commonly known *how* any given complex wave form can be split up into such a series. It is the purpose of this article to supply such information, in the form of tables of constants which can be used in such analysis, and to discuss briefly the theory of the method, giving such instructions as are needed to carry out the analysis of the ordinary forms of waves encountered in practice. The greater part of the matter presented is not new, but the fact that methods of wave form analysis are not as generally known by active engineers as its importance warrants, may serve as a sufficient reason for presenting the following:

FUNDAMENTAL PRINCIPLES.

Fournier has shown, in a mathematical theorem bearing his name, that wave forms which are single-valued periodic functions, such as those of alternating currents, can be represented by a series, the first term of which is a constant and each of the terms following are sines and cosines of an angle multiplied by a constant. Expressed analytically any wave form can be said to be equal to:

$$A + A_1 \sin \omega t + B_1 \cos \omega t + A_2 \sin 2\omega t + B_2 \cos 2\omega t + A_3 \sin 3\omega t + B_3 \cos 3\omega t + \ldots + A_\eta \sin n\omega t + B_\eta \cos n\omega t. \quad (1)$$

Where the A and B factors are the amplitudes of the various sine and cosine component waves; ω equals a constant angular velocity, and so ωt represents an angle varying with time.

By the proper choice of the X axis along which t is measured, the first constant, A, will reduce to zero while no change will take place in the other factors. The condition for this is that the two halves of the wave, above and below the axis, shall have equal areas. As the alternating-current waves encountered in practice are plotted thus, the discussion following will be based on that assumption.

It will be seen on inspection of equation (1) above that its factors occur in pairs, sines and cosines of the same angles. By a simple trigonometric transformation, these factors in pairs, i. e. $A \sin \omega t + B \cos \omega t$, can be expressed as a single function of the same angle and made to appear as $C \sin (\omega t + \Theta)$.

The method of making this transformation and determining the constants, C and Θ, is as follows: Looking at Fig. 1, where the three factors are represented on the left-hand side of the figure by the three lines diverging from a common center, o, the relation between them will be seen at once.

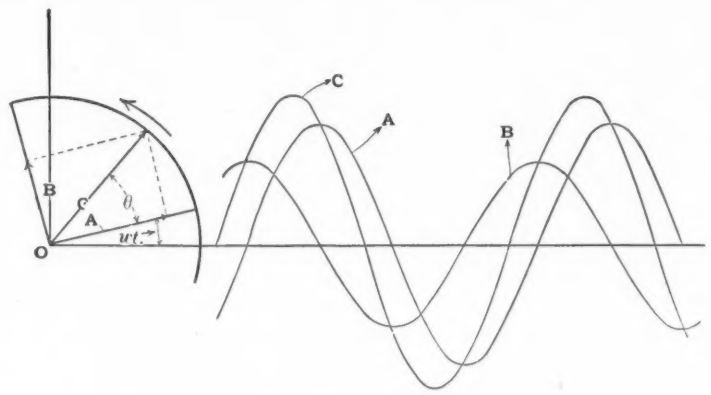


FIG. 1.—METHOD OF DETERMINING CONSTANTS.

The lines, as radii vector, are all rotating about o, with a constant angular velocity, ω. All three are at fixed angular relations to each other, and C is seen to be the resultant of A and B, at a fixed angular position to A, determined by the relative values of A and B. The angle, Θ, is seen to be one having a tangent equal to B/A. It is perfectly evident that the numerical values of C is $\sqrt{A^2 + B^2}$.

The right-hand side of Fig. 1 shows the three sine curves that the radii vector, A, B and C, would develop if the sines of the angles are plotted as ordinates and the angles as abscissæ, the angles being measured between the horizontal axis and the respective radii. It will be seen on inspection that the instantaneous value at any point on curve C is equal to the sum of the values of A and B taken at the same point, care being taken to allow for change of sign for all values below the axis; consequently, curve C is a correct representation of the resultant of the two curves, A and B.

The method of performing the transformation, then, for a given expression, $A \sin \omega t + B \cos \omega t$, is indicated thus:

$$\sqrt{A^2 + B^2} \sin (\omega t + \tan^{-1} B/A).$$

The various sine waves into which a complex wave can be subdivided are known as fundamental and harmonics, the fundamental having the same frequency as the complex wave from which it is derived. The harmonics may have any multiple frequency, though in general only the odd frequencies will occur, as will be explained later. Thus a sine wave of a given frequency, such as three times that of the fundamental, representing the sum of a sine and a cosine wave of the same frequency, is known as the third harmonic. The sine and cosine factors from which a particular harmonic is determined are known as the sine and cosine components of that harmonic.

The components of the various harmonics being more readily determined than the harmonics proper, and their phase relations, that method is the one generally used. After the components are determined it is a simple matter to perform the transformation indicated above, and thus get the harmonic and its angle of lead or lag.

The fact that

$$\left.\begin{aligned} &\int_0^{\pi} \sin x \sin nx \, dx \\ &\int_0^{\pi} \sin x \cos nx \, dx \\ &\int_0^{\pi} \cos x \cos nx \, dx \\ &\int_0^{\pi} \sin x \cos x \, dx \end{aligned}\right\} = 0.$$

(Where n is any integer other than unity)

is the fundamental principle upon which is based practically all of the methods of harmonic analysis.

With the above in mind, it becomes evident that if any complex wave, expressed as a series of sine and cosine component harmonics, is multiplied by a test wave, such as $\sin nx$, and all these products integrated between the limits indicated above, the result will be zero for each and every term excepting the sine component of the harmonic of frequency n. If the result of the entire operation is zero, it is proof that there is no sine component of that particular harmonic present. It is evident, then, that the components of the various harmonics are picked out, one at a time, by the use of test waves. Thus, to determine if the sine component of the nth harmonic is present, the complex wave series is multiplied by a sine wave of unit amplitude and a frequency n times that of the fundamental, and all products reduce to zero on integration, save the sine component of the nth harmonic, if such is present. Such an operation expressed analytically would, after integration, stand thus:

$$0 + 0 + 0 + 0 + \int_0^{\pi} \sin nx \, A_\eta \sin nx \, dx + 0 = \frac{A_n \pi}{2}$$

The indicated integral is the equivalent of the area of a curve formed by the products of all ordinates of the two sine waves of the same frequency, but different amplitudes. This area is seen to equal $\frac{A_n \pi}{2}$, and A_n is the value that is desired. Thus A_n is equal to $\frac{2}{\pi}$ multiplied into the result of the entire operation of multiplication and integration.

What has been said regarding the determination of the sine components is equally true regarding the cosine components, and they are determined in a similar manner, using cosine testing waves in the latter case, of course.

While the above indicates the correctness of principles, it is not enough to enable one to actually analyze a wave such as is determined experimentally, as it would be simply a curve on paper without any analytical series expressed. What is wanted, then, is some way of summing the products of every ordinate of the complex wave into those of the various test waves. For an analytical method, where

no recourse is had to any mechanical integrating device which would also allow for the products with the test wave, the best that can be done is to select a definite number of evenly-spaced ordinates of the complex wave form, measure them, multiply them by ordinates in the corresponding angular relations of the test waves, and sum the products. Such a method would be an approximate integration of the products of the test wave and the series, and the result of such an operation must relate only to the sine or cosine component of the harmonic of the same frequency as that of the test wave, according as the test wave is a sine or a cosine function.

The amplitude of the component harmonic is determined from the residue of the last operation by multiplying it by 2 divided by the base of the complex wave, which in numerical value will equal the number of equal parts into which the base is divided.

Todhunter has proven the truth of the above statements in his integral calculus, and expresses the value of the amplitude of the sine, or cosine components of any harmonic, *m*-, in the following manner:

$$A_m = \frac{2}{n+1}\left[e_1 \sin\left(m\frac{180}{n+1}\right) + e_2 \sin\left(2m\frac{180}{n+1}\right) + e_3 \sin\left(3m\frac{180}{n+1}\right) + \ldots\ldots + e_n \sin\left(nm\frac{180}{n+1}\right)\right]$$

$$B_m = \frac{2}{n+1}\left[e_1 \cos\left(m\frac{180}{n+1}\right) + e_2 \cos\left(2m\frac{180}{n+1}\right) + e_3 \cos\left(3m\frac{180}{n+1}\right) + \ldots\ldots + e_n \cos\left(nm\frac{180}{n+1}\right)\right]$$

Where the symbols have the following meanings:

A_m = amplitude of the sine component of the mth harmonic.
B_m = amplitude of the cosine component of the mth harmonic.
n = number of measured ordinates.
e_1, e_2, e_3, e_n = values of the measured ordinates taken in the regular order of sequence in which they were measured.

Using these formulæ, it is seen how, by dividing the base of one alternation of the complex wave to be analyzed into $n + 1$ equal parts and measuring the n ordinates at the points of division, it is possible to determine the sine, or cosine component of any harmonic desired.

In performing such an operation there is considerable labor involved in determining the various trigonometric values indicated.

TABLE I. WAVE FORM ANALYSIS.

Meas. Ord.	A_1	B_1	A_3	B_3
	.087	.996	.259	.966
	.174	.985	.50	.866
	.259	.966	.707	.707
	.342	.94	.866	.5
	.423	.906	.966	.259
	.5	.866	1.0	.0
	.574	.819	.966	−.259
	.643	.766	.866	−.5
	.707	.707	.707	−.707
	.766	.643	.5	−.866
	.819	.574	.259	−.966
	.866	.5	.0	−1.0
	.906	.423	−.259	−.966
	.94	.342	−.5	−.866
	.966	.259	−.707	−.707
	.985	.174	−.866	−.50
	.996	.087	−.966	−.259
	1.0	.0	−1.0	.0
	.996	−.087	−.966	.259
	.985	−.174	−.866	.5
	.966	−.259	−.707	.707
	.94	−.342	−.5	.866
	.906	−.423	−.259	.966
	.866	−.5	.0	1.0
	.819	−.574	.259	.966
	.766	−.643	.5	.866
	.707	−.707	.707	.707
	.643	−.766	.866	.5
	.574	−.819	.966	.259
	.5	−.866	1.0	.0
	.423	−.906	.966	−.259
	.342	−.94	.866	−.5
	.259	−.966	.707	−.707
	.174	−.985	.50	−.866
	.087	−.996	.259	−.966
	A_1=.0555×	B_1=.0555×	A_3=.0555×	B_3=.0555×

TABLE II. WAVE FORM ANALYSIS.

Meas. Ord.	A_5	B_5	A_7	B_7
	.423	.906	.574	.819
	.766	.643	.94	.342
	.966	.250	.966	−.259
	.985	−.174	.643	−.766
	.819	−.574	.087	−.996
	.50	−.866	−.5	−.866
	.087	−.996	−.906	−.423
	−.342	−.94	−.985	.174
	−.707	−.707	−.707	.707
	−.94	−.342	−.174	.985
	−.996	.087	.423	.906
	−.866	.5	.866	.5
	−.574	.819	.996	−.087
	−.174	.985	.766	−.643
	.259	.966	.259	−.966
	.643	.766	−.342	−.94
	.906	.423	−.819	−.574
	1.0	.0	−1.0	.0
	.906	−.423	−.819	.574
	.643	−.766	−.342	.94
	.259	−.966	.259	.966
	−.174	−.985	.766	.643
	−.574	−.819	.996	.087
	−.866	−.5	.866	−.5
	−.996	−.087	.423	−.906
	−.94	.342	−.174	−.985
	−.707	.707	−.707	−.707
	−.342	.94	−.985	−.174
	.087	.996	−.906	.423
	.5	.866	−.5	.866
	.819	.574	.087	.996
	.985	.174	.643	.766
	.966	−.259	.966	.259
	.766	−.643	.94	−.342
	.423	−.906	.574	−.819

TABLE III. WAVE FORM ANALYSIS.

Meas. Ord.	A_9	B_9	A_{11}	B_{11}
	.707	.707	.819	.574
	1.0	.0	.94	−.342
	.707	−.707	.259	−.966
	.0	−1.0	−.643	−.766
	−.707	−.707	−.996	.087
	−1.0	.0	−.5	.866
	−.707	.707	.423	.906
	.0	1.0	.985	.174
	.707	.707	.707	−.707
	1.0	.0	−.174	−.985
	.707	−.707	−.906	−.423
	.0	−1.0	−.866	.5
	−.707	−.707	−.087	.996
	−1.0	.0	.766	.643
	−.707	.707	.966	−.259
	.0	1.0	.342	−.94
	.707	.707	−.574	−.819
	1.0	.0	−1.0	.0
	.707	−.707	−.574	.819
	.0	−1.0	.342	.94
	−.707	−.707	.966	.259
	−1.0	.0	.766	−.643
	−.707	.707	−.087	−.996
	.0	1.0	−.866	−.5
	.707	.707	−.906	.423
	1.0	.0	−.174	.985
	.707	−.707	.707	.707
	.0	−1.0	.985	−.174
	−.707	−.707	.423	−.906
	−1.0	.0	−.5	−.866
	−.707	.707	−.996	−.087
	.0	1.0	−.643	.766
	.707	.707	.259	.966
	1.0	.0	.94	.342
	.707	−.707	.819	−.574

As these values are in no way dependent upon the wave under investigation, but depend only on the number of equal divisions into which the base is divided, it is evident that a table of constants can be determined for use with a particular number of base line divisions. Such a table has been devised and is submitted in the following form as one that is convenient to use. It is based on the assumption of a base line division of thirty-six equal parts—an ordinate every five degrees of the fundamental—and can be used for that, or for an eighteen-part base line division, where so great accuracy is not required. To obviate the labor and liability of error in transcribing these constants every time it is desired to use them, it is suggested that copies of the tables be made on some duplicating machine such as a mimeograph, leaving blank columns for calculations as in the arrangement of the tables I to V.

It will be noticed that the constants are calculated for the odd harmonics only. This is for the reason that all wave forms that are symmetrical about the X axis contain only the odd harmonics; the even harmonics always produce a lack of symmetry between the alter-

nations above and below it. As most of the wave forms encountered in practice are of that type, it was not considered advisable to in-

TABLE IV. WAVE FORM ANALYSIS.

Meas. Ord.	A_{13}	B_{13}	A_{15}	B_{15}
	.906	.423	.966	.259
	.766	—.643	.5	—.866
	—.259	—.966	—.707	—.707
	—.985	—.174	—.866	.5
	—.574	.819	.259	.966
	.5	.866	1.0	.0
	.996	—.087	.259	—.966
	.342	—.94	—.866	—.5
	—.707	—.707	—.707	.707
	—.94	.342	.5	.866
	—.087	.996	.966	—.259
	.866	.5	.0	—1.0
	.819	—.574	—.966	—.259
	—.174	—.985	—.5	.866
	—.966	—.259	.707	.707
	—.643	.766	.866	—.5
	.423	.906	—.259	—.966
	1.0	.0	—1.0	.0
	.423	—.906	—2.59	.966
	—.643	—.766	.866	.5
	—.966	.259	.707	—.707
	—.174	.985	—.5	—.866
	.819	.574	—.966	.259
	.866	—.5	.0	1.0
	—.087	—.996	.966	.259
	—.94	—.342	.5	—.866
	—.707	.707	—.707	—.707
	.342	.94	—.866	.5
	.996	.087	.259	.966
	.5	—.866	1.0	.0
	—.574	—.819	.259	—.966
	—.985	.174	—.866	—.5
	—.259	.966	—.707	.707
	.766	.643	.5	.866
	.906	—.423	.966	—.259

TABLE V. WAVE FORM ANALYSIS.

Meas. Ord.	A_{17}	B_{17}
	.966	.087
	.174	—.985
	—.966	—.259
	—.342	.94
	.906	.423
	.5	—.866
	—.819	—.574
	—.643	.766
	.707	.707
	.766	—.643
	—.574	—.819
	—.866	.5
	.423	.906
	.94	—.342
	—.259	—.966
	—.985	.174
	.087	.996
	1.0	.0
	.087	—.996
	—.985	—.174
	—.259	.966
	.94	.342
	.423	—.906
	—.866	—.5
	—.574	.819
	.766	.643
	.707	—.707
	—.643	—.766
	—.819	.574
	.5	.866
	.906	—.423
	—.342	—.94
	—.966	.259
	.174	.985
	.996	—.087

clude the even harmonics in the table above. Any one desiring to determine the value of the even harmonics, in a case where such is necessary, can do so by calculating the values required from the Todhunter formulæ given above.

Another characteristic of wave forms is worthy of note in passing. That is, all wave forms symmetrical about both the X axis and the middle ordinates of each alternation have zero as the value of the cosine component of all harmonics. The truth of this is readily seen from the relations of the constants under the various $B's$; they are all symmetrical, but of opposite sign, about their middle value. The cosine components all reducing to zero, shows that all harmonics pass through one of their zero values at the same time that the fundamental does.

It is seldom one has an opportunity of utilizing this last characteristic in investigating wave forms determined experimentally, but it can be used in studying assumed wave forms of that type.

INSTRUCTIONS FOR USING THE TABLES OF CONSTANTS.

It is intended that the following instructions shall be complete enough, so that any one can perform the operations of the analysis without having read over all the preceding discussion of the principles.

First, take the wave to be analyzed and divide the base line into thirty-six equal parts, starting at the zero value of the wave. Erect ordinates at each point of division and measure their values. Place the values of these measured ordinates in the left-hand column of the table, marked "Measured Ordinates." Next, multiply each measured ordinate by the constants in the various columns opposite; this is quite readily done by means of a slide rule. The two blank columns are left to the right of each column of constants in order that the positive and negative products can be placed in separate columns and thus render the addition of the columns more certain. All the columns of products should be added and the difference between the positive and negative values determined for each set of pairs of columns. This difference for each is then multiplied by the constant .0555, care being taken to preserve the sign of each oper-

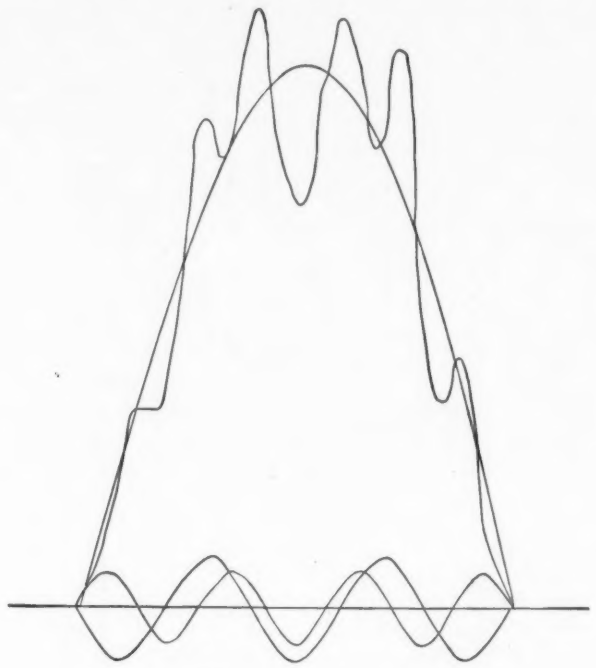


FIG. 2.—FIFTH HARMONIC OF THE CURVE.

ation. The products resulting from the constant .0555 into the various differences are values of the amplitudes of the respective component harmonics, the number of the harmonic being indicated by the subscript of the letter A, heading the columns of the constants in the table, for the sine components and the letter B, for the cosine components.

Having determined the components of the various harmonics, as described above, the harmonic is determined thus: Its amplitude is $\sqrt{A^2 + B^2}$, and the harmonic goes through its nearest zero value to the zero value of the fundamental, at an angle whose tangent is B/A, ahead, or behind the fundamental as determined by the signs of A and B. The rule for determining angles between the fundamental zero and the nearest harmonic zero to it, is as follows: If A and B are both positive, the harmonic is ahead of the fundamental less than 90°, by an angle whose tangent is B/A; if A is negative and B positive, the harmonic is ahead, an angle less than 180°, but greater than 90°, whose tangent is B/A; if A is negative and B negative the harmonic is lagging at its zero nearest the fundamental zero by an angle less than 180° and greater than 90°, whose tangent is B/A; if A is positive and B negative, the angle of lag is less than 90° and is the angle having a tangent equal to B/A.

As an illustration of the above instructions, the fifth harmonic of the curve, of which one alternation is shown in Fig. 2, will be determined.

The thirty-five measured ordinates are placed in the left-hand column of the table of constants for the two component curves of the fifth harmonic, the multiplications and summations made, as will be seen in the following tabular form:

$A_5 = .0555 \times -14.737 = -.817,$
$B_5 = .0555 \times -1.531 = -.084.$

The two components of the fifth harmonic can now be written as

$$-.817 \sin 5\omega t - .084 \cos 5\omega t.$$

Resolving the two component waves into the resultant harmonic, thus:

$$\sqrt{(-.817)^2 + (-.084)^2} = .822,$$

the value of the amplitude; the angular relation is gotten as the angle whose tangent is $\frac{-.084}{-.817} = 5° 52'$. The rule given above, for determining the sign of the angles as well as their size, states that when both components are negative, the angle is a lagging one,

TABLE VI. WAVE FORM ANALYSIS.

Meas. Ord.	A_5			B_5		
.79	.423	.334		.906	.715	
1.24	.766	.95		.643	.797	
2.23	.966	2.15		.259	.578	
3.32	.985	3.27		—.174		.577
3.35	.819	2.74		—.574		1.92
3.32	.50	1.66		—.866		2.87
4.06	.087	.353		—.996		4.04
5.695	—.342		1.945	—.94		5.35
8.05	—.707		5.69	—.707		5.69
8.12	—.94		7.63	—.342		2.77
7.44	—.996		7.41	.087	.646	
7.95	—.866		6.87	.50	3.97	
9.58	—.574		5.50	.819	7.85	
10.00	—.174		1.74	.985	9.85	
8.40	.259	2.175		.966	8.12	
7.66	.643	4.93		.766	5.87	
6.87	.906	6.22		.423	2.91	
6.73	1.00	6.73		.00		
8.15	.906	7.38		—.423		3.45
9.13	.643	5.87		—.766		7.00
9.82	.259	2.545		—.966		9.48
9.40	—.174		1.634	—.985		9.26
8.20	—.574		4.71	—.819		6.71
7.63	—.866		6.60	—.50		3.815
8.81	—.996		8.77	—.087		.766
9.30	—.94		8.74	.342	3.18	
6.68	—.707		4.72	.707	4.72	
4.65	—.342		1.59	.94	4.37	
3.64	.087	.316		.996	3.625	
3.44	.50	1.72		.866	2.975	
4.20	.819	3.44		.574	2.41	
3.41	.985	3.36		.174	5.27	
1.775	.966	1.715		—.259		4.60
.98	.766	.75		—.643		.63
.507	.423	.214		—.906		.459
		58.822	73.549		67.856	69.387
			58.822			67.856
			—14.737			—1.531

greater than 90° and less than 180°: this case reduces to an angle then of 174° 8′. The harmonic as finally determined is written thus:

$$.822 \sin (5\omega t - 174° 8').$$

A complete analysis, up to the 17th harmonic, of the wave above, Fig. 2, gives the following:

$$9.02 \sin (\omega t + 0° 23') + .0825 \sin (3\omega t + 57° 26')$$
$$+ .822 \sin (5\omega t - 174° 8') + .607 \sin (7\omega t + 10° 40')$$
$$+ .433 \sin (9\omega t + 158° 36') + .482 \sin (11\omega t + 93° 3')$$
$$+ .029 \sin (13\omega t - 37° 12') + .196 \sin (15\omega t + 137° 33')$$
$$+ .435 \sin (17\omega t + 51° 20').$$

The fifth, seventh and thirteenth harmonics are particularly prominent and have amplitudes of about ten per cent. of that of the fundamental. The fundamental, fifth and seventh harmonics are drawn in Fig. 2.

Radium and Terrestrial Heat

Prof. Rutherford, of McGill University, Montreal, in a lecture before the Royal Institution in London, has advanced the striking theory that the earth's heat is not attributable to a molten mass which has been slowly cooling for a million years, which has been the generally accepted theory, but to the presence of radium. Prof. Rutherford's address was listened to by a distinguished audience, including Lord Kelvin, Lord Rayleigh, Prof. Dewar and other great scientists. Prof. Rutherford was the first to measure the mass and velocity of the electrons of radium. He announced the probability of radium being contained in all matter.

Glimpses of Steinmetz.

In the June *World's Work* Arthur Goodrich tells some interesting stories about Mr. Charles P. Steinmetz, chief engineer of the General Electric Company at Schenectady. "One of his ablest assistants spent a number of days of hard work in solving an intricate mathematical problem. When he had finished it he asked Steinmetz to work it out. The inventor grasped the problem at once, counted on his fingers a few times, and gave the correct answer without touching pencil or paper. Yet he remarked recently: 'Mathematics is valuable only to obtain results. Mathematics for mathematics' sake is foolishness.'

"Some years ago Steinmetz went into the Adirondacks with a hunting party of friends. Not caring to hunt, he was often left alone at a little lodge that was made the party's headquarters. One night before the camp fire a mathematical question came into his head. To settle it he needed a table of logarithms which could not have been found within miles of the camp. He remembered a few figures, and in a short time had worked out an entire table of logarithms for himself, and from it solved the problem. This mathematical sense, which was originally trained by hard study at Breslau, makes it possible for him to answer quickly the rapid fire of questions his aids hurl at him daily.

"The laboratory workers come to him constantly for advice and direction. Eighteen thousand employees stand ready to work out his ideas. With the men he is always genial and democratic. When any business matter needs settling he does it in determined fashion. He is as independent as he is good-natured. When the heads of the works made a rule against smoking in the factory, Mr. Steinmetz said he would smoke or leave. He did not leave. 'He can accomplish more in an hour,' said one of his assistants, 'than I can do in a week.' If some difficult problem needs solution at the works, it is nearly always taken to Steinmetz.

"Not long ago there was an explosion in a manhole in New York City, which made great trouble for an electric railroad. Many local engineers tried to find the cause of the trouble, and gave various unsatisfactory explanations. The matter was brought to Mr. Steinmetz's attention. In a few moments he asked how certain adjacent wires in the manhole were covered. Here, indeed, was the trouble. It was simple, but no one else had thought of it. He takes the short cut to the essential thing. It is characteristic of all his work."

Recent Electrochemical Developments.

Two patents granted on May 17 to Mr. Alfred H. Cowles, of Cleveland, refer to methods of manufacturing calcium carbide. There is nothing new of a fundamental nature in his method since the carbide is produced simply by heating a mixture of lime and carbon to a high temperature. The patents refer rather to details of the method. Mr. Cowles intends to make the operation continuous and superheats the carbide so that it may be easily tapped off.

A patent granted to Mr. R. N. Pelton, of Detroit, Mich., refers to an electric furnace for dentists. Its essential part is a muffle with a heating coil of platinum wire in the wall. The outside of the muffle is surrounded by another heating coil.

Mr. P. J. Boucher, of Cleveland, Ohio, patents an apparatus for purifying water by electrolysis with the aid of aluminum electrodes. As well known, a flocculent hydrate is thereby produced which coagulates the various impurities and allows them to be easily removed from the liquid by settling or filtering. If the current always goes in the same direction, deposits form on the electrodes and interfere with their action and the electrodes unequally deteriorate. To counteract this tendency, the inventor automatically reverses the current at predetermined periods of time. He also provides means for automatically relieving the pressure of the gases evolved by electrolysis and for insuring the current being turned on or off whenever the liquid is turned on or off.

A patent granted to Mr. F. Hinz, of Berlin, Germany, refers to a process of manufacturing peroxides of magnesium and zinc in a diaphragm cell. For making magnesium peroxide he uses an aqueous solution of magnesium chloride in the anode compartment and a neutral solution of magnesium chloride and hydrogen peroxide in the cathode compartment. Magnesium deposited on the cathode by the action of the current reacts with the hydrogen peroxide and yields magnesium peroxide.

Discussion of Institute Papers.

The discussion of the papers read before the recent annual meeting of the American Institute of Electrical Engineers was quite extensive, particularly that of the first day. The paper by Mr. W. L. Waters on "Predetermination of Sparking in Direct-Current Machines," and that of Mr. E. H. Anderson on "Effect of Self-Induction on Railway Motor Commutation" were discussed together. Referring to the latter paper, Mr. Waters said that Mr. Gano S. Dunn some ten years ago proposed the method outlined for finding the self-induction of commutation. In reference to the statement that one cannot run with impunity 5, 6 or 7 coils per slot, he pointed out that this is due to the peculiar conditions of a railway motor. An oscillagram shows that the field of the armature is almost constant over quite a considerable distance; and though one may be commutating under different conditions for different coils, yet the field is almost constant. A series current motor with a brush on the neutral point is a special case, having little relation to the ordinary direct-current machine.

Mr. E. R. Douglas pointed out that there are two systems of flux giving rise to self-induction. A great part of the flux goes directly across the slots above the coil and through the wire itself, but a further and larger portion spreads out in all directions and flows parallel to the shaft as well as along the shaft. He gave an account of experiments made by the Crocker-Wheeler Company, in which a sphere of high permeability was used with a circular coil lying on the surface, and discussed at length the results of the experiments. He also discussed other experiments by the same company having a relation to the subject of Mr. Anderson's paper. His conclusions were that there are very many things to be taken into account in a formula for sparking. Mr. Thornburn Reid discussed in detail the paper by Mr. Waters with reference to work that he has been doing on the same problem, which work he states is nearly at a point where he is ready to bring it before the Institute. He has found that for one set of brushes the variation of the current from what might be called perfect resistance commutation depends not on inductance e.m.f. alone, but on the ratio of the reactance and the contact resistances or the brush surfaces. He things that if this factor were used in place of that for reactance voltage there would be an entirely different relation in the variation of the constant. A further factor that affects the question is that of the frequency of the commutation periods. Referring to the calculation of self-inductance of an armature coil, Mr. Reid said that in his method, which differed considerably from that of Mr. Waters, instead of taking the depth of the slot he took only the depth above the winding.

In the discussion of Mr. Winship's paper on "The Calculation of Railway Storage Batteries," Mr. F. J. White said that the method of determining the average running current per car by station wattmeter readings will not give the variation of the current throughout the line, and very often that variation will determine where the central point with respect to the battery is located. In regard to the matter of sub-station storage batteries, he has found that with the average schedule of load, say, half-hour or hourly cars, it has been found economical to install storage batteries. Mr. Lamar Lyndon said that the results of Mr. Winship corresponded in general with those developed by Sarrat, of Brussels, and that he obtained similar results in 1902. In these latter, however, and in the formula of Mr. Sarrat, the internal resistance of the battery was taken into consideration, which factor Dr. Winship has apparently neglected, but which must be reckoned with. The character of the generator from which the load is supplied must also be considered, since it affects some of the factors in the formula offered. He referred to a specific case where, without considering these factors, the booster worked out at 24 kw, whereas when the factors mentioned were taken into consideration, the size came out at 12 kw.

Mr. E. H. Anderson criticised the formula of Mr. Waters as not taking into consideration all of the important factors and went into considerable detail with relation to the principles of sparking. Mr. Winship in replying to Mr. Lyndon, said that in his experience it was not possible to obtain a value of the internal resistance of a battery that could be worked with. In using the calculations as they appear in his paper, he has been able to come out within a very few per cent. of observed results.

President Arnold said that in sub-station work he has in general made it a practice to connect each terminal cell to a line and connect to the bus-bar so as to go in and out of the cells to keep the feeders properly charged and keep track of the batteries. He usually installs 4, 5 or even 10 or more cells than needed in practical operation. Owing to the variable conditions, the best calculation seldom hits the proposition on the start. Mr. F. D. Newbury supplemented the paper by Mr. Lamme on "A 10,000-cycle Experimental Alternator," with notes on the measurement of voltage, iron loss tests, short-circuit tests and effects of high-frequency currents. Mr. J. H. Cuntz referred to a somewhat similar machine designed by Mr. Tesla in 1890 for high-frequency experiments at Columbia College, which was operated at from 10,000 to 12,000 cycles and was designed for 20,000 cycles. In general appearance the machine was similar to that described in the paper.

In the discussion of the paper by Mr. Barnes on fly-wheels, Prof. Franklin went at length into the question of parallel operation. He said that he had worked out a mathematical development, the denominator of which covered two pages and the numerator covered seven pages of paper. Prof. Clarence Feldmann, of Darmstadt, Germany, confirmed Mr. Barnes in a statement that in the case of gas engines driving alternators a lighter fly-wheel and heavy damping are needed. In the case of any prime-mover with small uniformity of speed a light fly-wheel and heavy damping are required. He referred to a formula by Boucherot for the fly-wheel, which he thought was the best that had been offered. He said that in designing he never used a damper, but used steel poles, which act partly as dampers. By the use of heavy fly-wheels and the natural damping produced either by steel poles or by coils short-circuited on top of each pole, trouble from hunting may be avoided. Prof. Feldmann referred to several specific cases of parallel operation in which the difficulties due to damping had been overcome by various arrangements. Prof. Franklin, after concluding the reading of the paper, on "The Induction Motor," supplemented it with some remarks in which he referred to the difference between the theory which he offered and that of Mr. Steinmetz on the same subject.

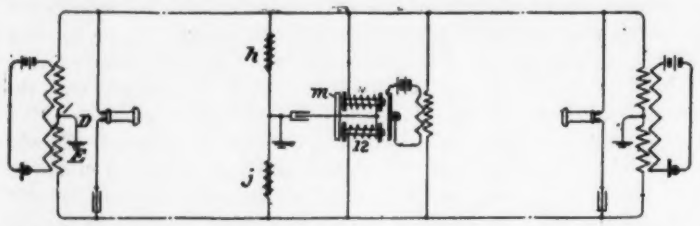
In a further discussion of the paper by Messrs. Waters and Anderson, Prof. Feldmann said that Mr. Waters greatly underestimates the influence of the shape of the pole pieces, and the reactance voltage is only the sole criterion as to sparking for one special type of machine. He believed that Mr. Anderson's statement that a motor of identically the same design will commutate better at 150 than 500 volts, is somewhat misleading or inexact. At the same current and speed and half the field the commutation will be worse. If, however, only half the current is taken at half the volts, the commutation will be better. He agreed with Mr. Reid that not only the self-induction, but also the mutual induction between the adjacent armature coils, should be taken into account in the sparking problem, and that other points should be considered, such as the frequency, and the contact resistance of the brushes. He stated that Prof. Arnold, of Carlsrhue, with the assistance of Prof. Mic, of Kiel, in 1898 completed and solved the differential equation applying in commutation, and in Prof. Arnold's book the formula is given with all the data necessary to figure self and mutual induction for any arrangement of coils in the slot.

Mr. H. Ward Leonard referred to a statement of Mr. Anderson in regard to sparking effects in starting the series motor for railway operation, and he considered that this was inherent in the type. For railway operations the best effects can be obtained by having the field of a motor separately and continually excited. He referred to experiments with an automobile where with series motors separately excited the automobile gave much better service than with self-excited fields. The automobile climbed with the same load and the same grade, with an expenditure of 120 watts in the field instead of 1,100. He referred to the experiments in Switerland with the Ward Leonard system in connection with heavy railway work, in which difficulty with commutation at the generator was at first experienced, but which difficulty has been entirely overcome. He stated that a 20-km. trial of the railway system would shortly be made in Switzerland. The source of power is 15,000 volts alternating. The locomotive, which is capable of developing about 1,000 hp, has a single-phase motor which drives a direct-current generator, the armature of which is connected in multiple with the armatures of the motor. A separate machine excites the generator field and also excites the motor fields. In the generator field is a rheostat which enables the magnetism of the field to be reversed or given any degree of magnetism desirable, so that the entire control of the locomotive in starting, accelerating, retarding, stopping or reversing is all accomplished by the manipulation of one handle.

New Telephone Patents.

REPEATING SYSTEMS.

If one considers the metallic circuit telephone line in contrast to the grounded line, its predecessor, it seems very natural that early telephone managers were so loth to abandon the latter, for not only does the metallic circuit require double the length of wire, but incidentally the line resistance to be talked through at the same time is approximately doubled. If, however, by some means the two wires of our metallic circuits could be used in parallel, not only would the low-resistance conditions of grounded circuits obtain, but even this resistance would be halved. In a new repeating system just brought out, such a result is approached, in that for at least a considerable portion of the line the two conductors do work in parallel. The system referred to is that described in a patent recently issued to J. J. O'Connell, of Chicago, and assigned to the American Telegraph & Telephone Company. In the figure is shown a diagrammatic view of a completed through connection, at the middle being shown



O'CONNELL APPARATUS FOR AMPLIFYING AND REINFORCING TELEPHONE CURRENTS.

the repeating station and at the ends the two subscriber's stations. The operation may be best made clear by tracing the talking current from one station to the other. Consider the left-hand station. Current in the primary of two induction coils, varying in response to the transmitter, induces currents in the secondaries. These latter are so poled as to impress upon their junction point, *D*, which is grounded, equal currents of like sign, and similarly to send out upon the two sides of the metallic circuit two equal currents of like sign. These currents complete their circuit though the earth to which they pass at the repeating station through the coils of the repeater, *m*. Thus for transmitted or "sent-out" currents, as far as the repeating station the line wires serve in parallel. At the repeating station the incoming currents are cumulative in effect and actuate the diaphragm, thus sending out upon the line a repeated current.

As will be readily understood from the circuit diagram, this repeated current uses the advance line as a metallic circuit. At the receiving station practically all current passes through the telephone as the two induction coil secondaries, which in series form only shunt circuit about it, have in this relation such a high impedance as to be of no effect. Operation in the reversed direction is, of course, exactly similar. It may be well to state that the coils, *h, j*, at the repeating station serve to relieve the line of extraneous currents which might affect the repeater. To this end these coils are wound of low resistance, but of high inductance.

The ringing generator patent, issued to E. H. Strauss, describes a separately excited generator, the electromagnetic field being supplied from a battery. The automatic generator switch contains elements to control the field current so that the circuit will be closed only during the time of actual signalling.

CURRENT NEWS AND NOTES.

CONVENTION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—The twenty-third annual meeting of the Association of Railway Telegraph Superintendents will be held at Hotel English, Indianapolis, Ind., June 15 and 16 next. Papers on topics relative to telegraphs and telephones will be read, and there is promise of a meeting of unusual interest. The members will probably proceed to St. Louis in a body to visit the Exposition. Mr. P. W. Drew, Milwaukee, Wis., is secretary of the Association.

INVESTIGATING RUBBER SUPPLY.—The United States Government is making investigations and has already issued a bulletin upon the subject of rubber gathering in the Philippines. It is known that in some of the southern islands the Hevea or Para rubber tree grows as perfectly as it does upon the Amazon and its tributaries, and in all of the islands the Castilloa or Mexican rubber tree can be made to grow. This is a matter of extreme importance to the Philippines and of the utmost interest to the American trade in general.

WHERE NEPTUNE DROWSES.—In the *Booklovers' Magazine* for June, Mr. P. T. McGrath has a very interesting article on life at St. Pierre Miquelon, the last Atlantic stepping stone for Europe. Water pipes running from reservoirs in the hills, and electric lights replacing the quaint oil lamps whose ornamental iron brackets still adorn the street corners, are the sole evidences of modern progress. There are no trams, street cars, telephones, newspapers, theatres, laundries or other accessories of advanced existence. Everything is sleepy, restful, and old-fashioned. Save for the Atlantic cable which touches there, it is as isolated from the world as Greenland.

DEPRECIATING THE STEAM ENGINE.—Writing under the title of "The Superseding of Steam Power," in the June *World's Work*, Lewis Nixon says: "I have been led, lately, to think the whole development of the steam engine, to the exclusion of the gas engine, has been a mistake, and that we are now at the beginning of a new era in the use of power. Engineers could to-day gain better and more economical results by abandoning steam and using internal combustion engines, even in large establishments. The gain in economy of fuel will advance with the size of the establishment. With the internal combustion engine, a brake horse-power can be produced on a pound of coal. This could not be done with steam under any conditions.

LETTERS TO THE EDITORS.

Reduction of Titanic Chloride.

To the Editors of Electrical World and Engineer:

SIRS:—We read on page 525, Vol. XLI of the ELECTRICAL WORLD AND ENGINEER (No. 13, of March 28, 1903), a note of Mr. Townsend, according to which a patent has been granted to Mr. Howard Spence, of Manchester, for the electric reduction of titanic chloride to titanous chloride. This conveys an impression that Mr. Spence had alone a right of carrying out this reduction.

We take the liberty of pointing out to you that the electric reduction of titanic chloride to titanous chloride has been put at everybody's free disposal through a publication of E. Polidori, which appeared in the beginning of the year 1899. (See *Zeitschrift für Anorganische Chemie*, Vol. XIX, page 306, and *Chemisches Zentralblatt*, 1899, Vol. I, page 518.)

NÜRNBERG, GERMANY. PAUL ASKENASY.

Italian Transmission Line Construction.

To the Editors of Electrical World and Engineer:

SIRS:—I have in hand the issue of your journal of March 12 and I tender my very best thanks for the lengthy editorial notice of my paper on "High-Tension Construction." I desire, however, to clear up some points which, it would appear, were not made thoroughly plain in the paper.

A system of land expropriation at so much per pole is extensively in use all over Europe. Of course, there are cases in which the full right of way is purchased, but even in these cases distinction is made between right of way and occupation of land; the first is paid at so much per meter of line, while the second is paid at so much per pole.

Referring to climatic difficulties, the writer of the editorial seems to consider the climate all over Italy as the climate of Naples and Rome, thus forgetting that most of the important lines run from the Alps, where snow, wind and variations of temperature are very severe. On the other hand, I do not very well understand how severe climatic conditions may be an objection to long spans and iron poles. If such conditions are to be met, it is purely a matter of introducing suitable data in the calculations, and to give the wires such a sag that the strain will not reach the limit of elastic deformation in the coldest weather and with the maximum overload put on by the wind and the snow, and to proportion the poles in accordance. Only by suitable calculations can one be sure of arriving at a solid

construction, and where difficulties are great, the recourse to sound engineering, which does not halt at severe conditions, is justified.

As to wooden poles, I quite agree that, if in any country they can have a considerable life, this would be an argument in their favor. The life of wooden poles differs very much according to locality; on mountains they will last very long, in cultivated plains they will have a very short life. The fact that the average life of wooden poles is longer in America than in Europe, may perhaps depend on the fact that in America the most important transmission lines run through mountainous country, while in Europe a large number of such lines, after passing through valleys, come out on cultivated plains where irrigation is extensively practiced.

On the other hand, I do not think there is any danger from rusting of iron poles. Rusting is prevented by repainting, and it may be observed that no bridge has ever been known to break down through the action of rust.

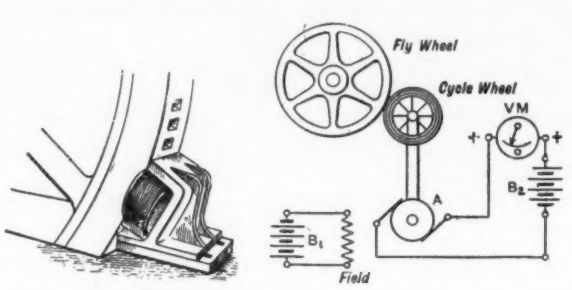
The editorial emphasizes the use of cross arms to prevent trouble from insulators breaking, and I may say that by the use of good modern insulators, the occurrence of such inconveniences is quite insignificant; and the use of cross arms as suggested in order to prevent the consequences of accidents which in practice very seldom occurs, detracts from the many mechanical advantages of metallic construction.

MILAN, ITALY. GUIDO SEMENZA.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

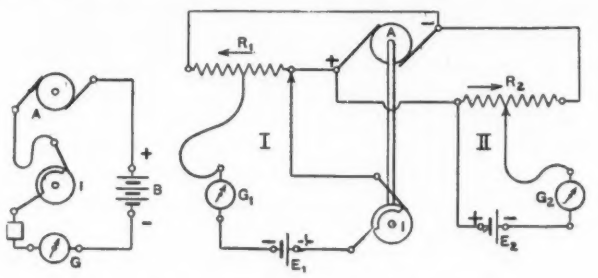
DYNAMOS, MOTORS AND TRANSFORMERS.

Alternators in Parallel and the Coefficient of Speed Variation.—BOHLE.—The conclusion of his long paper on this subject. He deals with the operation of a synchronous generator in parallel with a non-synchronous generator and then discusses the connection in parallel of alternators driven by gas engines. The difficulties are here great on account of the great speed variation and because the coefficient of speed variation varies according to the load. The latter difficulty may be overcome by loading an incoming machine artificially. Dettmar uses for this purpose a Foucalt brake which acts on the fly-wheel as shown in Fig. 1. The magnet is excited by direct



FIGS. 1 AND 2.—ALTERNATORS IN PARALLEL.

current, the load being regulated by means of a regulating resistance. The heat produced by these currents is kept low by the air currents, especially as the proceedings last only a short time. On account of the artificial load, the regulator of the engine has a position which corresponds to the load, so that the machine will take over part of the load of the other machine immediately. The faucault brake acts at the same time as a damper, diminishing the mechanical fluctuations. The author then discusses the various methods for determining the coefficient of speed variation. Electrical methods are the only accurate ones and even these cannot be relied upon, when the coefficient of speed variation is less than 1/200. Fig. 2 represents a method of the General Electric Company. A cycle wheel is fixed on the shaft of the small direct-current generator. The rubber tire is braced against the fly-wheel of the engine and the excitation of this generator is such that its e.m.f., corresponding to the mean speed, is equal and opposed to the pressure of a battery, B_2. Between the armature of the generator, A, and the battery, B_2, is joined a Weston



FIGS. 3 AND 4.—ALTERNATORS IN PARALLEL.

voltmeter with a low-reading scale. It will be evident that, if the fly-wheel rotated at a uniform speed, equal to the mean, the voltmeter would show no reading; but as the fly-wheel is rotating with a varying speed within a revolution, the voltmeter needle will oscillate, the amplitudes from the zero position being a measure of the variation of speed. A modification of this method by Franke is shown in Fig. 3. The armature, A, and the indicator, I, are coupled to the engine, the indicator closing the circuit once in a revolution at a definite crank position, causing a deflection on the galvanometer, G, which is proportional to the instantaneous pressure at this instant, hence also to the corresponding annular velocity. By bringing the brushes of the indicator into different positions the circuit will be closed at a different time. This method would be very accurate, if the time of a revolution would not change, but on account of this the instantaneous velocity changes with each revolution, so that the pressures for the same brush position are not constant at different times. To avoid this fault, the arrangement of Fig. 4 may be employed, in which the influence of the changeable time is considered. Here the pressure of the armature, A, is closed by the high resistances, R_1 and R_2. There are thus two circuits. On account of the drop in R_1 the back pressure, E_1 (at the instant the circuit is closed) is compensated, say, by means of the galvanometer, G_1. The pressure, E_2, is compensated similarly by G_2, which should possess a periodic damping and a fairly large periodic time. Galvanometer G_2 shows, therefore, only changes in the number of revolutions, or, in other words, the changes in the time of a revolution. Observations must be made in circuit I at the time when the galvanometer, G_2, shows no deflection, all observations will then correspond to the same time. It is seen that two persons are required for the experiment, which requires a great deal of time and patience. Irregularities in the pressure due to the construction of the experimental generator, must, of course, also be eliminated beforehand. Very small coefficients, that is to say, those below 1/200, cannot be determined. The author describes briefly the use of phase lamps, etc., and finally describes an apparatus of Goerges for demonstrating the oscillations of parallel running alternators.—Lond. *Elec.*, May 6.

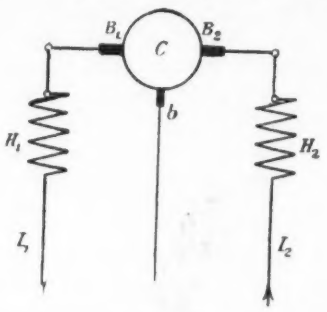


FIG. 5.—COMPOUNDING DIRECT-CURRENT MACHINES.

Compounding of Single Machines Supplying a Three-Wire System.—ROSENBERG.—If a single direct-current machine for supplying a three-wire network is to be compounded, the series winding is generally placed in the two outers, I_1 and I_2, as indicated in Fig. 5 by the coils, H_1 and H_2. But this division of the series winding is not

always possible. The author shows that the arrangement of Fig. 6 is equivalent. Here the coil, *H*, is inserted in one outer, and the coil, *h*, in the neutral, while the second outer has no excitater winding. Fig. 6 shows the arrangement of Debrowolsky, where the neutral wire is connected to the central point of an induction coil, *T*, the two

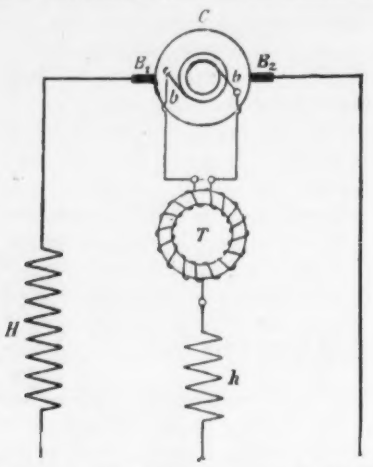


FIG. 6.—COMPOUNDING DIRECT-CURRENT MACHINES.

terminals of which are connected to two slip rings on two diametrically opposite points of the armature. The number of turns of *h* must be one-half of *H*. The cross-section of the winding, *h*, is to be determined according to to the value of the differential current, which it has to carry.—*Zeit. f. Elek.* (Vienna), May 1.

REFERENCES.

Alternators.—ATCHISON.—The first part of an illustrated paper, read before the Birmingham Section of the British Institute of Electrical Engineers, on some properties of alternators under various conditions of loads. After some brief remarks on the e.m.f. on open circuit, he discusses the e.m.f. induced with the machine loaded, both for non-inductive and inductive load, diagrams being given.—Lond. *Elec.*, May 6.

Alternators.—HAY.—In a continuation of a serial on the theory of alternators he gives, with the aid of diagrams, the analytical and graphical theory of the "ideal alternator."—Lond. *Elec. Mag.*, April 26.

Single-Phase Commutator Motors.—SUMEC.—A conclusion of his serial illustrated by diagrams. He deals with the repulsion motor and the shunt motor.—*Zeit. f. Elek.* (Vienna), May 8.

LIGHTS AND LIGHTING.

Illumination of Incandescent Bodies and Temperature.—JABLONSKI.—A communication referring to a recent article of Eisler. He points out that his results are in agreement with a former law of Rasch, according to which the total illumination, Φ, increases with the temperature, T, according to the differential equation, $d\Phi/\Phi = Kd\,T/T^2$.—*Elek. Zeit.*, May 5.

POWER.

Power Station Design.—MERZ AND MCLELLAN.—A continuation of their British Institute paper, the first part of which was abstracted in the Digest last week. The authors say that the question of spare plant and its proportion to the output of the station is an important one in design, as also is that of securing the correct relative capacity of the various pieces of apparatus making up a complete unit: the boiler, engine, generator and switch gear. They emphasize that the steam turbine lends itself admirably to dealing with large overloads. They discuss eight different methods in which the station may be rated. In a plant where the load factor over a year may be expected not to exceed 25 or 30 per cent., low cost of production will be facilitated by the engineer considering capital expenditure rather from the point of view of the most economical way of dealing with a peak load. In other words, in estimating the capital cost, he considers that the rating of the station should be based on the maximum possible output which the station is capable of dealing with for one or two hours, making no allowances for spare plant. The authors consider that by proper attention to spares and overload capacity the cost per kilowatt of maximum output of a power station can be reduced from 20 to 40 per cent., depending, of course, on the load factor to be dealt with. They then deal with auxiliary machinery, and recommend electric driving for the machinery in the boiler house and for the circulating and air pumps. For the feed pumps they recommend to install at first steam-driven feed pumps and to use electrically-driven feed pumps for extensions. Concerning the method of electric driving the auxiliary machinery, they recommend to have in view the ultimate adoption of driving from separate generating sets, with the addition of a connection to the main bus-bars to meet emergency conditions. But for the first installment they recommend the use of polyphase auxiliaries operated through stationary transformers from the main bus-bars, without, for the time being, providing any alternative source of supply. They also offer the following possible method as being quite attractive. It consists in driving the whole of the auxiliaries from the particular main unit which they serve by connecting stationary transformers direct to the alternator terminals, these transformers being of sufficient capacity to operate air pumps, centrifugal pumps, stoker, induced-draft fan, and even, if desired, feed pumps—all in permanent connection through a switch with the main unit. In starting up, the switches controlling air pumps and centrifugal pumps may be left in and the field of the main generator excited. These auxiliaries would then start up with the main machine just as if they were mechanically coupled or geared to it. Flexible connections would be provided so that motors, feed pumps or induced draft fans could be used as spares for other sets, but normally each main unit would deal with its own auxiliaries and would be independent of all others. In an editorial discussion of the paper emphasis is laid on the point brought out by the authors that economy in capital expenditure is as important as economy in works cost.—Lond. *Elec.*, May 6.

REFERENCES.

Steam Turbines.—LONDON.—An article illustrated by diagrams on steam turbines for electric generating stations, with some comparisons with the reciprocating engine.—Lond. *Elec.*, April 26.

Emmet.—A paper on new steam turbine developments, illustrated by various diagrams. He deals with the development of the Curtis turbine and gives some notes on the 5,000-kw turbine installed in the new plant of the Chicago Edison Company and of a 2,000-kw machine of the new four-stage type recently tested under the conditions of vacuum and superheat afforded by the Schenectady power station. He thinks that the four-stage machine will hold its own against all competing engines for some time to come, and that it will be extensively used.—*Proc. Engineers' Club, Philadelphia,* April.

Lifting Apparatus.—REICHWALD.—An illustrated description of electrical lifting apparatus for iron and steel works, especially of block charging cranes, and loading cranes.—Lond. *Elec. Mag.*, April 26.

Blast Furnace Gas Engines.—ALLEN.—In a continuation of a serial on the application of electricity to mining and metallurgy he deals with the utilization of the blast furnace gases for driving gas engines.—Lond. *Elec. Mag.*, April 26.

TRACTION.

Double-Current Generators for French Traction System.—A fully illustrated description of the electric tramway line from Aix to Marseilles. The length of the line is 30 km. and each train consists of a motor car and a trailer and makes the return trip five times per day. Each motor car is equipped with two 36-kw motors. The power plant contains three double-current generators supplying both direct current direct to the line and three-phase currents to step-up transformers, which send high-tension three-phase currents to sub-stations in which the current is changed to direct current by step-down transformers and synchronous converters. The converters are in parallel with the direct-current side of the double-current generators, so that there is a very close interrelation between the different machines in the power plant and the sub-stations. There is a good distribution of the load and the generators supply more or less direct current or three-phase current, according to whether motor cars are nearer or farther away from the power plant. The following advantages are claimed for this system over that of the generation of three-phase currents to converter sub-stations: one sub-station at the power plant itself is avoided; there is no loss at the power plant itself in the conversion of three-phase currents to direct currents; the only high-tension apparatus used are transformers. The main difficulty to be overcome in this system was that the same voltage must exist at the commutators of the double-current generators and of the converters, whatever may be the load. It was, therefore, necessary

to compensate for the loss of voltage in the transformers, the line and the converters. Such an automatic compensation was obtained by special construction of the transformers with high self-induction and by compounding the converters. The power house contains three double-current generators, two of 200 kw and one of 100 kw. They furnish direct current at 650 volts and three-phase currents at 400 volts. The voltage of transmission of the three-phase currents is 10,000. There are two sub-stations, one containing one transformer and a 120-kilovoltamp. converter, while the other one contains two sets of the same kind.—*L'Ind. Elec.,* April 25.

Direct-Current Versus Single-Phase Traction.—HOBART.—The conclusion of his article. The author continues to discuss Lincoln's comparison of the single-phase and direct-current system for a 60-mile road. He introduces such corrections for Lincoln's single-phase figures as he considers to be justifiable, and he substitutes, moreover, for the 600-volt, direct-current system with sub-stations a system with two direct-current generating stations, located respectively 15 miles from each end of the system and 30 miles from one another. These stations he assumes to be equipped with slow-speed 1,350-volt direct-current generators, and the cars are fed at an average voltage of 1,300. Each car carries two 650-volt motors connected in series and operated as a 1,300-volt unit. The acceleration is rheostatic. He gives a table of comparative costs and arrives at the result that the single-phase system is 12 per cent. higher in first cost and 7 per cent. higher in operating expenses than the direct-current system for the items which he takes into consideration. He assumes two power houses for the direct-current system, since this arrangement is fairly suitable for Lincoln's line and for 1,350 volts at the generators; but for extensive lines polyphase generation from a single station would often be preferable. He concludes that his comparison affords ground for the opinion that the superiority of the single-phase motor for other than main line work is as yet by no means a foregone conclusion. Nevertheless, the single-phase commutator motor represents a very important advance. It is beyond all comparison superior to the single-phase motor without commutator, and is already not greatly inferior to polyphase motors and direct-current motors. This is an excellent record for such a brief period of development.—Lond. *Elec. Rev.,* May 6.

Electric Headlight.—CARNEY.—An abstract of a paper on the electric headlight as an adjunct to modern railway practice. It acts as a safety device by giving a warning to the public that a high-speed train is approaching. But an electric headlight burning in a switch-yard is a nuisance. One main disease of it is the effect of the diverging rays on the vision of the engineman during snow, rain or mist. To overcome this difficulty a cylindrical extension about 15 in. long has been fitted to the ordinary headlight. This gives a sharper pencil of light and seems to illuminate the track better than the standard one.—*Eng. News,* May 19.

Traction Motor for Small Gauge Roads.—BOEHM AND RAFFAY.—An illustrated review of the development of traction motors by the Oerlikon Company with special reference to a 900-volt, 110-hp motor for small gauge roads. It weighs 1,700 kg., when tested for one hour with a load of 105 hp, the increase of temperature in the field coils was 70° C. over the temperature of the surroundings, while the commutator and the armature had a smaller temperature. The insulation of the windings was tested with 3,000 volts alternating currents. —*Elek. Neu. Anz.,* April 15.

Egypt.—A description of the first Egyptian steam line to be converted to electric traction. The combined system comprises the Alexandria Traction Company and the Alexandria & Ramleh Railway. The main line of the latter is a standard-gauge, double-track road joining Alexandria and Ramleh. The principal features are the use of heavy rails, center-pole construction, high-voltage alternating-current transmission system with rotary converter sub-stations and compound condensing engines in the power plant.—*St. R'y Jour.,* May 7.

Electric Traction in Germany.—JACQUIN.—A description with maps of the tramway systems of Hamburg and Kiel.—*La Revue Elec.,* April 30.

Rail Bonding.—SHEARDOWN.—The first part of a paper read before the Dublin Section of the British Institute of Electrical Engineers, on tramrails and rail bonding. The author states that while there have been many forms of solid or continuous rail joints thought out and patented, yet the only three which have had any amount of use in practice are the Falk cast-welded joint, the electric-welded rail joint of the Lorain Steel Company, and the thermit joint. In the present installment the first two mentioned systems are described.—Lond. *Elec.,* May 6.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

An Apparatus for Making out Bills to Electricity Consumers.—BIERMANN.—A paper read before the Berlin Electrical Society. The author emphasizes the amount of money which is yearly spent by large electric supply companies for rendering the bills to their customers. The meter is read by a man, then at the office the consumption is calculated, multiplied with the constant of the meter, again multiplied with the rate at which the energy is charged for, the bills are made out and the money is collected. Then there is much trouble with customers, who claim that their meter is wrong. He describes a meter in which most of the above work is done in the meter itself and the consumer is always enabled to read at once from the meter how much money he has spent for electric light every day. If there is really something wrong about the meter the consumer will soon find it out and then put in his claim at once, and there will not be any trouble at the end of a longer period. His meter is essentially a combination of an ordinary electricity meter with a calculating apparatus and a printing device. In this way the bill is directly made out by the meter. The instrument is described in detail and illustrated.—*Elek. Zeit.,* May 5.

WIRES, WIRING AND CONDUITS.

Earthing of the Neutral Point in Three-Phase Systems and the Watt Loss in the Dielectrics of Cables.—HUMANN.—An article in which the author calls attention to the advantages in earthing the neutral point in three-phase systems. The safety of the system against accidents is thereby increased. At the same time the watt loss due to dielectric hysteresis in the cable network is considerably diminished. This loss is for high-voltage networks considerably greater than is generally assumed, and this loss exists whether current is consumed in the network or not. The author has made experiments with a three-core, three-phase, high-tension cable of 3×25 sq. mm. copper cross-section, of 890 meters length. The insulating layer of impregnated paper was 6.8 mm. thick between copper and lead, as well as between the different copper conductors. His results are applied to a comparison of the watt loss in the following two cases: In the first case the neutral point is earthed; in the second case one phase is earthed. He remarks that the latter case may easily occur in practice. For 100 km. of his cable, operated at 5,000 volts, the loss amounts to about 23,000 kw-hours per year, if the neutral point is earthed, and to about 35,200 kw-hours, if one phase is earthed. If the cost of 1 kw-hour is assumed to be 2.5 cents, the earthing of the neutral represents a saving of $304.40. For higher tensions this saving is much more considerable; for 10,000 volts it amounts to $1,209. The earthing of the neutral point is preferably carried out in the power house by means of a special conductor of sufficient cross-section.—*Elek. Zeit.,* May 5.

Inductive Voltage Drop in Parallel Three-Phase Lines.—LICHTENSTEIN.—The conclusion of his article. In practice the voltage drop of parallel conductors carrying three-phase currents is often calculated as follows. To determine the voltage drop in the set of conductors 1 and 2 one calculates the voltage drop in conductor 1 and the voltage drop in conductor 2 and forms their geometrical sum. By voltage drop in conductor 1 is meant the geometrical sum of the ohmic voltage drop and the inductive voltage drop per conductor, the latter being calculated by the formula for two parallel single-phase conductors. This method of calculation, if applied to three conductors in one plane (as is often the case in three-phase railways) gives accurate results only for the voltage drop between the two outers of the three wires. For the voltage drop between 1 and 2 and for the voltage drop between 2 and 3 the results are wrong by a few per cent. The author emphasizes, however, that by such a method of calculation the term "voltage drop in a conductor" is introduced, which he endeavors to show has no physical significance. The calculation of the voltage drop is much easier if the three conductors are so arranged that a cross-section through them gives an equilateral triangle.—*Zeit. f. Elek.* (Vienna), May 1.

ELECTRO-PHYSICS AND MAGNETISM.

Revolving Electrostatic Field.—GUYE AND DENSO.—An illustrated description of an arrangement for producing a revolving high-tension

electrostatic field, which they use for making experiments on the dielectric hysteresis in revolving fields. The arrangement is shown in Fig. 7, in which A_1 and A_2 are two points connected to a single-phasealternator. R is a non-inductive resistance, C an adjustable capacity and L an induction coil. A_1, B andA_2 are connected to the four plates, 1, 2, 3, 4, as shown. The authors derive the mathe-

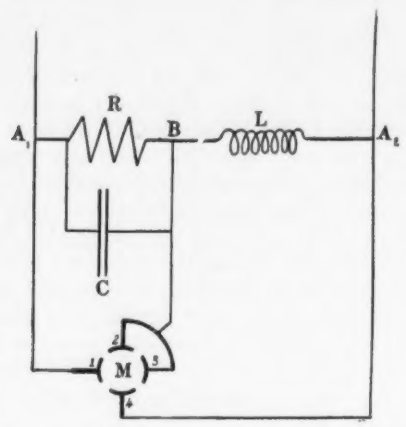


FIG. 7.—REVOLVING ELECTROSTATIC FIELD.

matical relations which must be fulfilled between R, C and L, in order to produce a circular revolving electrostatic field at M.—*L'Eclairage Elec.*, May 7.

Conductivity of Sodium.—BERNINI.—An account of an experimental investigation of the influence of temperature on the electric conductivity of sodium. The main results are that sodium is one of the best conductors of electricity; its conductivity decreases with increasing temperature, and it appears that the law of proportionality is nearly fulfilled within the limits of his investigation; the temperature coefficient is larger for liquid sodium than for solid sodium; the change of resistivity at the melting point is represented by a sudden rise, in the proportion of 1 to 1.337. The specific resistance at 0° C. is 0.050407 and at 120° C. 0.093062. Just below the melting point, at 97.3°, it is 0.0655, and just above the melting point, at 98.5°, it is 0.088. The melting point is, according to his measurements, 97.633° C.—*Phys. Zeit.*, May 1.

REFERENCES.

Hertzian Waves and Phosphorescence.—GUTTON.—An account of experiments in which he found that not only does the induced e.m.f. due to the variation of a magnetic field brighten a calcium sulphide screen, but Hertzian oscillations, producing, as they do, very intense e.m.f's, do the same.—*Comptes Rendus*, April 18; Lond. *Elec.*, May 6.

Flames Between Electrodes.—An account of an experimental investigation of the electric current through flames placed between two nearby electrodes, some experiments being made with calcium oxide electrodes.—*Phys. Zeit.*, May 1

UNITS, MEASUREMENTS AND INSTRUMENTS.

System of Electrical Units.—FOURNIER D'ALBE.—A communication referring to the suggestion of Robertson, whose radical changes could only be justified on the ground of finality, but such a claim cannot be made for them. The advance of the electron theory is gradually reducing the whole of electromagnetic theory to a theory of the electron at rest and in motion. The present author emphasizes that the natural unit of electricity is the electron itself, or, since it is inconveniently small, some multiple of it, preferably a trillion electrons, which might be called the "trelectron." A coulomb would be about five trelectrons. A current of one ampere would be generated by the passage of five trelectrons per second through any cross-section of the conductor. One trelectron would repel another at a distance of one meter in air with a force of 40,000,000 kg. Putting ξ for the new fundamental unit of electric quantity he gives the new dimensions of several electric units; for instance, current $= \xi T^{-1}$. The conductivity comes out as the density of electrons multiplied by mobility, the mobility being the steady velocity acquired by an electron under unit force acting upon it within the conductor.—Lond. *Elec.*, May 6.

Hay.—Another communication on the same subject. He emphasizes the innate conservatism of human nature. "Will any number of resolutions or recommendations passed at international electrical congresses induce the host of designers to abandon their present methods merely in order to satisfy the fastidious taste of their scientific confrères? And if not, what advantage is there in tampering with the existing system, beyond the somewhat imaginary one of eliminating the innocent yet much-abused 4π from certain equations, merely in order to have it reappear in others?" He thinks that "such unfamiliar terms" as abfarads, abcoulombs, gausses, gilberts, abstatvolts are "certainly more remarkable on the score of originality than on that of euphony." He thinks there is the danger with any attempt to alter the existing system that it would create two distinct systems, one for use by theorists and the more enlightened engineers, the other by those who are merely concerned with the more or less mechanical application of general principles to practical problems. The only result would be to make the language of the scientific investigator much less intelligible to the practical man than it is at present.—Lond. *Elec.*, May 6.

Measuring the Energy of Short and Rapidly Decreasing Electric Currents.—WEICHSEL.—A mathematical article on the measurement of the energy of very short and very rapidly decreasing electric currents; thus problem is of importance for telegraphy and electric clocks. He shows that if a dynamometer is used with a period of oscillation which is very large compared with the duration of the current to be measured, the reading of the first deviation of the needle gives the time integral of the squares of the instantaneous currents. On the other hand, a ballistic galvanometer gives the time integral of the instantaneous currents. If the current, the energy of which is to be measured, is sent through the fixed coil, while the movable coil, in series with a very high non-inductive resistance, is shunted across the terminals of the apparatus in which the current is consumed, the energy of the short and rapidly decreasing current is proportional to the first deviation of the needle of the instrument. He gives rules of the application of Thomson's quadrant electrometer and of the Curie electrometer. His equations are valid for undamped instruments only. He finally introduces the corrections which must be made on account of the damping.—*Zeit. f. Elek.* (Vienna), May 8.

REFERENCES.

Pyrometry.—GHEURY.—The first part of a paper on the various methods used in pyrometry. He dwells specially on the three standard methods which have actually left the experimental stage and are of current use in practice, that is the gas thermometer, the resistance thermometer and the thermo-electric thermometer.—Lond. *Eng'ing*, May 6.

Barbed Damping Device.—FAVÉ AND CARPENTIER.—A description of a new device for damping oscillations which combines a very small moment of inertia with a high damping coefficient. It consists of a stellar arrangement of very thin glass fibres or natural hairs, fastened to the oscillating needle with its plain horizontal and its center in the axle of oscillation. The fibres used have a diameter of about 1/10 mm.—*Comptes Rendus*, April 18; Lond. *Elec.*, May 6.

MISCELLANEOUS.

Comet Tails.—An editorial summary of the hypotheses which have been proposed for the explanation of comet tails. Fitz Gerald has suggested that the Maxwellian light pressure exerted by solar radiation on the molecules of a gaseous cometary envelope might be the cause of the observed curvatures of the appendages. A difficulty, however, arises from the small absorption of radiation by gases, and Arrhenius has suggested that condensed particles of matter should replace the molecules of Fitz Gerald's hypothesis. On the basis of this hypothesis Schwarzchild has calculated the repulsion exercised by the sun's total radiation on a single particle and compared that force with the sun's gravitational attraction. He estimated that, on particles of the most favorable size, the radiation pressure might reach a magnitude about 20 times the gravitational attraction. As a matter of fact, astronomical measurements indicate a solar repulsive force about 40 times the attraction of gravitation. Thus, with the most favorable postulates, the Maxwellian light pressure theory has not yet afforded a complete explanation of the main phenomena. Perhaps it is a complex effect, however, some other distinct self-contained theories have been suggested. Fessenden thinks the tail may consist of particles carrying negative electricity which move under solar gravitation, nuclear electrostatic attraction and the electric repulsion of a negatively-charged sun. J. J. Thomson has suggested

that the sun's ultra-violet radiation disengages from the nucleus negative ions which are repelled by radiation pressure. This supposition seems to require the existence in solar radiation of Hertzian waves. Lastly, Bois has suggested that radioactive substances in the nucleus may give rise to charged atmospheres, which move in the electrostatic field of the sun.—Lond. *Elec.*, May 6.

Radium Rays for the Blind.—LONDON.—An account of experiments in which he attempted to utilize radium rays for the instruction of the blind. Although the rays probably exert some feeble effect upon the optic nerve, they act in a much more pronounced manner upon the retina, and whatever effect can at present be produced is conditional upon the retina, or some small portion of it, having retained its susceptibility for light. If a box containing a radium preparation is approached towards the head of a person whose eyes are bandaged, he perceives a general diffused luminosity which is centered to some extent towards the direction of the box. With some practice the subject can indicate the direction in which the box is situated, and if the operator traces lines and curves in front of his eyes, with the box, he can trace them out after him with a fair amount of accuracy. But the practical value of these observations is annulled by the fact that the rays are very dangerous to the eyes, leading easily to retinitis and blindness. On the other hand, the rays may be usefully employed in conjunction with a platino-cyanide screen. The author encloses such a screen in an opaque frame, which is held in front of the eye in a dark room. Objects are shown as silhouettes on the screen, and the blind subjects are told their shapes as first, with the aid of the sense of touch, and when they acquire some practice they are able to trace them out themselves. In this way the reading of raised letters is greatly facilitated, the vague visual impression strengthening the actual perception. Ordinary screens illuminated with electric light were also tried, but were found to irritate the eye by the heat rays.—*Archives d'Elec. Medicale*, April 25; Lond. *Elec.*, May 6.

REFERENCES.

Electric Separation of Oil from Condensed Feed Water.—A note on experiments made by Davis and Perrett, of London, who found that whereas with untreated condensed water it was practically impossible to remove the oil by mechanical filtration, this can be done if the water is first subjected to electrolytic action. For this purpose some tap water must be added to the mixture in order to increase its conductivity. The water is passed through a wooden tank between iron electrodes, a potential of 50 volts being maintained between adjacent plates, and is subsequently filtred.—*Power*, April.

Electricity in Agriculture.—GUARINI.—The first part of a serial on electricity in agriculture. The author emphasizes that experiments and observations have shown that electricity is able to have good effects on the growth of plants. This influence may be either direct by the electrification of the ground, the plant, the atmosphere, or indirect, by means of lighting with the voltaic arc. He begins to give a summary of the results obtained in this direction by various investigators.—*L'Elec.*, May 7.

Radio-Therapeutics.—BERGONIÉ.—An account of a case of cure of a cancroid cancer of the eyelid by Röntgen rays. The patient was a woman of 63 years, suffering from cancer of the eyelid and the orbid of 20 years' standing, but recently accelerated. Röntgen rays of sufficient intensity to penetrate the thorax were applied to the eye through an aperture in a lead screen during 11 sittings of five minutes each, extending over a month. Six weeks after the treatment the cancer had completely disappeard, laving the eye closed, indeed, but covered with a normal skin through which the eyeball could be felt to be in a normal condition.—*Archives d'Elec. Medicale*, April 25; Lond. *Elec.*, May 6.

New Books.

LA TELEGRAPHIE SANS FILS. By André Broca. 2 ième Édition. Paris: Gauthier-Villars. 234 pages, 52 ills. Price, 4 francs.

André Broca, who is professor of physics in the faculty of medicine in the École Polytechnique, Paris, issued the first edition of "The Telegraph Without Wires" in 1899, and his object at that time in writing the treatise was to present a non-technical account of the electromagnetic theory of light and its relation to wireless telegraphy in as simple a manner as possible.

Since then, as Prof. Broca states, in the preface of the second edition, the art has been very greatly extended and the theory of high frequency currents as well as the relation of electrical resonance to syntonization has become a constituent part of wireless telegraphy, and these subjects have been treated in the latter book. There are twelve chapters in all, the synthetic arrangement following more or less closely the works of other foreign writers on the same subject. There is little or nothing new in Broca's book, but the matter included is, however, presented in a readable manner.

DIE ANWENDUNG DER ELEKTRIZITAT FÜR MILITARISCHE ZWECKE. By Dr. Friedrich Wachter. Leipzig: A. Hartleben. 212 pages, 66 illustrations. Price, 4 marks.

The author has prepared a small handbook of practical information for those interested in the practical applications of the subject. The book is devoid of algebra or quantitative laws, and is divided into five chapters. The first is introductory and preliminary. The second is on military telegraph apparatus, including wire and wireless telegraphy, telephony and optical telegraphy. The treatment is very brief.

The third chapter relates to mine firing. The fourth refers to electric chronographs for determining the velocity of projectiles. This is probably the best chapter and the most modern. The last chapter is devoted to electric lighting motive power and miscellaneous applications.

In many directions the cuts and descriptions refer to archaic forms of apparatus and the book is not up to date in these respects. The treatment is, however, clear, concise and practical.

THEORIE UND ANWENDUNG DES ELEKTRISCHEN BOGENLICHTES. By H. Birrenbach. Hannover: Gebruder Janecke. 350 pages, 266 illustrations. Price, 9 marks.

This volume is a text-book of arc lamps, written by an engineer for engineering students. The graphical method of representing relative magnitudes is developed throughout and brief algebraic formulæ are used where necessary.

The book is divided into seven chapters. The first chapter contains a brief history of the subject and the general laws connecting current, pressure and arc dimensions. The second chapter gives a comparison between various sources of light, including enclosed and open arc lights, in reference to power, cost, etc. The comparison appears in general as unfavorable to enclosed arc lamps—the condition reverse to that holding in this country. Chapter III deals with arc photometry and the units employed. Chapter IV relates to the construction of arc lamps. The mechanisms of the more common forms of German arc lamps is described at considerable length. Chapter V considers the various methods of connecting arc lamps. Chapter VI is devoted to accessory arc lamp apparatus, such as transformers, resistances, indicators, etc.

Chapter VII relates to the applications of arc lamps. These are classified as follows: A, general applications; B, street lighting; C, interior lighting; D, projectors; E, photographic applications; F, medical applications.

The book concludes with a complete list of German arc light patents and an index of contents. The text is clear and the illustrations are excellent. The book will be valued by those interested in the practice of German arc lighting.

New Electric Organ for Denver.

One of the latest examples of church organ manufacture is now being installed in Denver, Colo., at the First Church of Christ, Scientist, Logan and Fourteenth Avenues. The instrument is of the electro-pneumatic type, and when it is completed will cost about $22,000. It contains about 3,200 separate pipes for tone production, ranging from what is called a "speaking length" of 32 ft. to a length of ⅜ of an inch, giving a range of audible vibration of from about 30 per second to 35,000 from the extreme bass to the extreme treble tones—that is, from the "tibia profundissima" to the "harmonic piccolo." The organ is composed of six separate organs: pedal, solo, swell, great, orchestral and echo. The keys are in four banks, each bank containing five octaves and one note, making a total of 244 keys. Each key sounds its proper note by closing a 5-volt circuit through a small horseshoe magnet about 2 in. long, wound with No. 22 wire. The armature of each magnet is about the size of a five-cent piece and covers small air holes which admit the proper air pres-

sure to the organ pipes. This pressure varies from that which will support a water column 5 in. high to that required to support 15-in. column. The electric contacts which are made by the keys are composed of gold wires and platinum strips. These contacts have an extremely low resistance, and do not oxidize as they are used. Current for the operation of the electro-magnets, which open and close the air valves admitting air to the pipes is supplied by a battery of Edison-Lalande cells, consisting of three parallel groups of five cells in series in each group. One group of five cells will operate the magnets.

The total number of stops in the organ is 48. The stops are operated by keys instead of the usual plugs, the organ being one of the only three in America to have this attachment. It is the second organ in the country to have double touch pistons, there being 28 of these peculiar button contacts on the four banks of keys. The object of these pistons is to enable the organist to bring various sets of stops into service without taking his hands from the key banks. Each piston makes two successive contacts, and each contact throws certain stops into operation, so that the old annoyance of having to pull out a long series of stops in securing various tone combinations is largely done away with, constituting an interesting example of the adaptation of the electric circuit as a time-saver in the complex process of rendering a difficult musical score. The platinum and gold contacts alone are valued at over $400. Some of the pedals have double contacts also; an innovation in organ design.

The echo organ is placed in the roof of the auditorium with a set of chimes. The main organ is placed behind and above the reading platform, and all the pipes and mechanism are concealed behind a wooden lattice of handsome design. The console, or playing desk containing the keys, pedals, stops and contacts, is stationary on the auditorium floor at the right of the platform. Compressed air brought through small lead pipes to the console is the agency for producing tonal effects set in combination by the various stop keys.

The organ receives its air supply from a No. 7 Sturtevant blower belt-driven from a 7½-hp, 500-volt, direct-current, two-pole General Electric shunt motor running at 1,650 r.p.m. This apparatus is located in the basement of the church, and is connected with the organist's switch cabinet by cables running in iron-armored conduit. The motor is run open, its closed capacity being but 5.5 hp. The organist's cabinet is a fire-proof recess lined with galvanized iron and asbestos located beneath the reading platform at the left of the console seat. It contains a double-pole, single-throw knife switch and a rheostat with automatic release, both of General Electric make. The organist thus can easily start the blower motor by simply turning to the left and without leaving his seat. The air supply from the blower is further controlled by a damper valve in the flue which leads from the blower room to the organ loft. Over 22 miles of electric cable are installed in the organ proper, and the various parts are lighted by 108-volt, 16-cp incandescent lamps, to facilitate inspection and repairs. This organ is the first in America to be equipped with "tibia plena" pipes.

The church building is a handsome new structure of lava stone, quarried near Salida, Colo. It is admirably lighted throughout by widely distributed incandescent lamps of the frosted bulb variety. The seating capacity of the building is about 1,900 and the total cost, approximately, $150,000. The organ is the work of the Austin Organ Company, of Hartford, Conn., to whose representative, Mr. Herbert Brown, the writer is indebted for these details.

Exhibits in the Electricity Building, St. Louis.

In the southwest corner of the Electricity Building is a complete exhibition of electric heating appliances made by the American Electrical Heater Company, of Detroit, Mich. The modern housekeeper finds that electricity is first a luxury then a necessity when the many labor-saving electrical appliances are placed at her disposal. With the electric smoothing iron she can laundry her own shirtwaists and neckwear, doilies and lingerie, and save many misgivings about her hand-made lace and embroidery. She simply removes a lamp from a socket, inserts a plug attached to a flexible cord and the iron keeps at a constant heat. The company shows a full line of cooking utensils, including complete ranges with ovens, boilers, etc. Individual appliances such as chafing dishes, coffee and tea pots, egg boilers, hot water urns, curling iron heaters are shown in different styles and sizes. Nearly every manufacturing industry needs some tool or apparatus to be heated, and electricity gives the most perfect heat known, as the heat can be conducted to a certain part of the appliance and kept there continuously at constant temperature, allowing the operator to do more and better work than by any other method. Over sixty different styles of pressing and smoothing, or laundry irons, are shown, ranging in weight from twenty ounces to thirty pounds. House and office heaters are shown as well as ovens, plate warmers, foot warmers, glue pots, griddles, pancake cookers, toasters, small stoves like a stove lid from four inches to

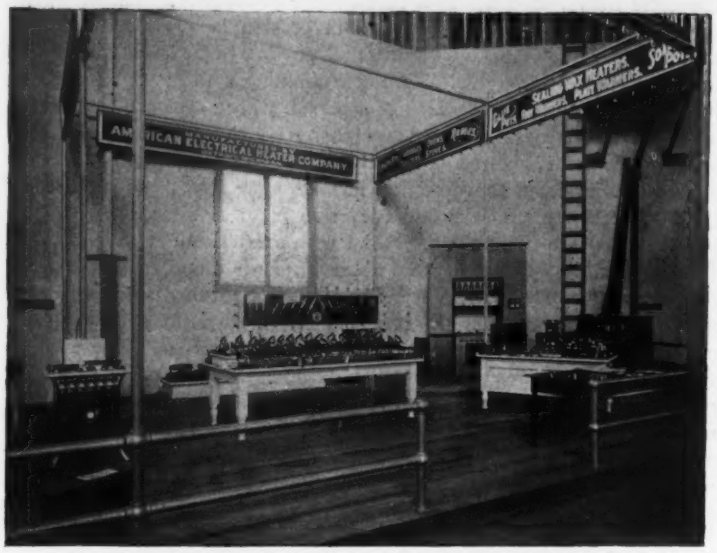


FIG. 1.—EXHIBIT OF AMERICAN ELECTRICAL HEATERS.

sixteen inches in diameter, laboratory plates giving seven heats in different sizes, branding irons for branding cigars and corks, wood-bending forms, soldering irons from ten ounces to four pounds in weight, and numerous other articles. Mr. B. H. Scranton, the president and general manager, was on the grounds for three weeks getting the exhibition in shape, and it was completed when the gates opened on April 30.

The space occupied by the Acheson Graphite Company, near the main entrance of the building, contains miniature electric furnaces which illustrate the processes of Mr. E. G. Acheson of manufactur-

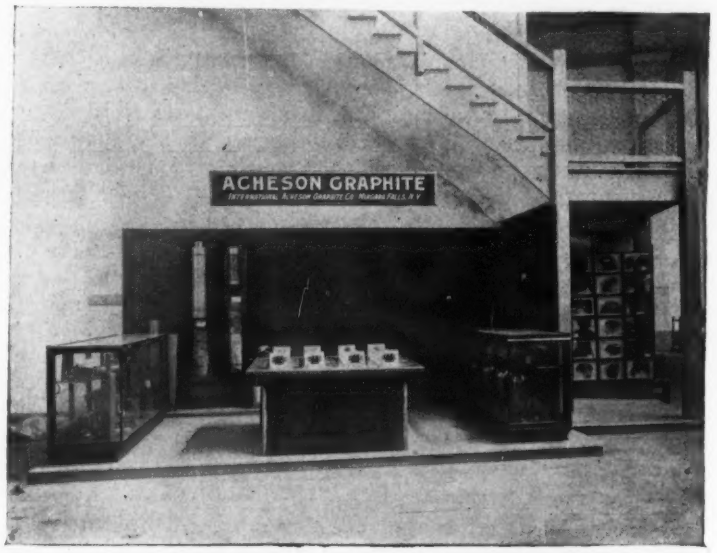


FIG. 2.—ACHESON GRAPHITE EXHIBIT.

ing graphite from anthracite coal or similar raw materials. The different grades of graphite and electrodes of various sizes and forms will be shown, the latter containing practical working samples of different anodes and electrodes as used by the customers of this company for electrolytic work. They illustrate the different methods of machining and assembling the graphite into economical anode forms. For electric furnace work, the electrodes can be joined together end to end and fed into the furnace one after the other as consumed without interruption of the furnace. The graphite bulk products will illustrate the importance of this article in the manu-

facture of paint, dry batteries, stove polish, motor-generator brushes, etc. Special attention is given to the use of this form of pigment for high-grade protective coatings on structural iron and steel.

The Hutchison Acoustic Company's booth and exhibit were completed at the opening and Mr. M. R. Hutchison gave demonstrations of his acousticon and massacon, electromagnetic instruments for the alleviation of deafness. Two congenital deaf mutes were

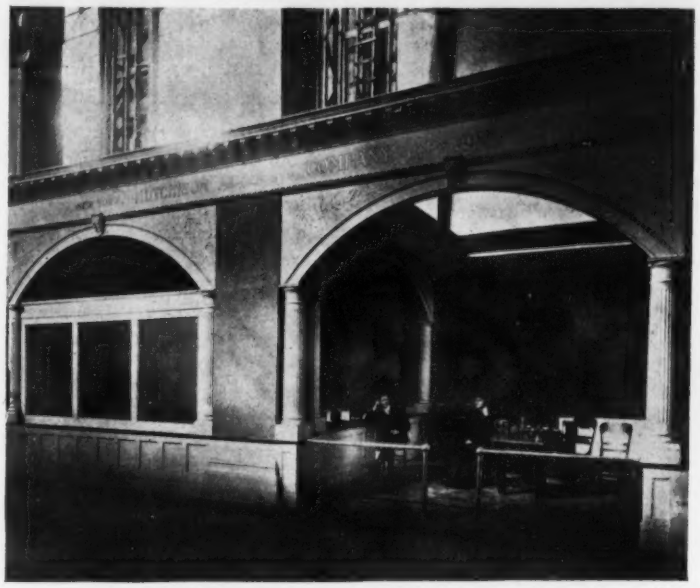


FIG. 3.—EXHIBIT OF HUTCHISON ACOUSTIC COMPANY.

provided by the Educational Department and these boys, who had heard no sound from birth, were made to hear music and the voice by using the acousticon. This instrument consists of a small battery, a specially-designed telephone receiver, and a transmitter which amplifies the sound and imparts the waves to auditory nerves. The massacon is a magnetic instrument which emits sound waves in sharp saw-tooth form and sets the ear drum and auricles in vibration, which stimulates them the same as massage to weakened muscles and restores the ear to normal condition.

The only underground exhibit in the Electricity Building is that of the McRoy Clay Works and the Standard Underground Cable Company near the northwest corner entrance. The installation of the conduit, manholes and cables is just as they are placed beneath the street surface. An excavation is made at one side so that the cross-section of the whole subsurface installation is open to view, as shown in the illustration. The cable reel and capstan are placed at the manholes ready for actual operation. Over the conduit aerial lines and cables are extended between two poles, and these serve to indicate the method of connection and distribution between the

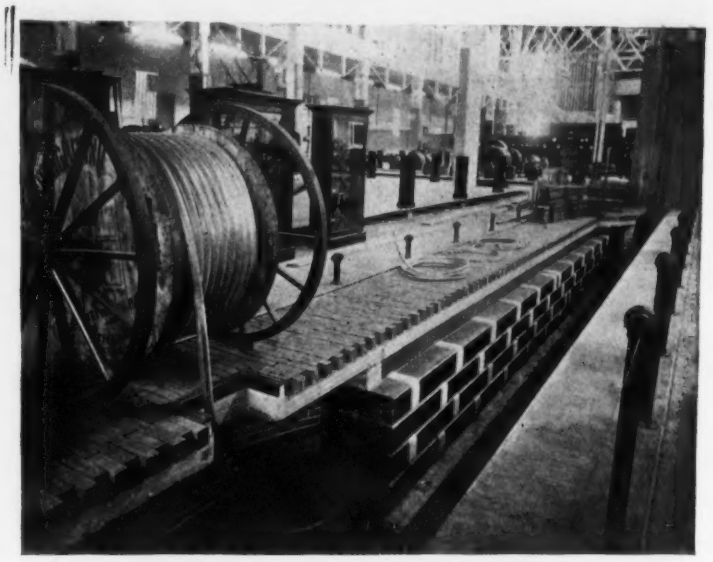


FIG. 4.—EXHIBIT OF M'ROY CLAY WORKS AND STANDARD UNDERGROUND CABLE COMPANY.

overhead and subsurface lines. A number of cabinets contain samples of telephone, lighting and power cables made by the Standard Underground Cable Company.

The Edison historical exhibit, made under the auspices of the Association of Edison Illuminating Companies, contains a collection of early generators, motors and other apparatus constructed under the personal direction of Mr. Edison when electrical engineering was in its infancy. About the walls of the exhibit spaces are hung photographs of the pioneers and their early work. The Jumbo dynamo, made by the Edison Machine Works, direct-connected to a high-speed engine, forms an interesting comparison with the model of the General Electric 10,000-hp Niagara generator, which

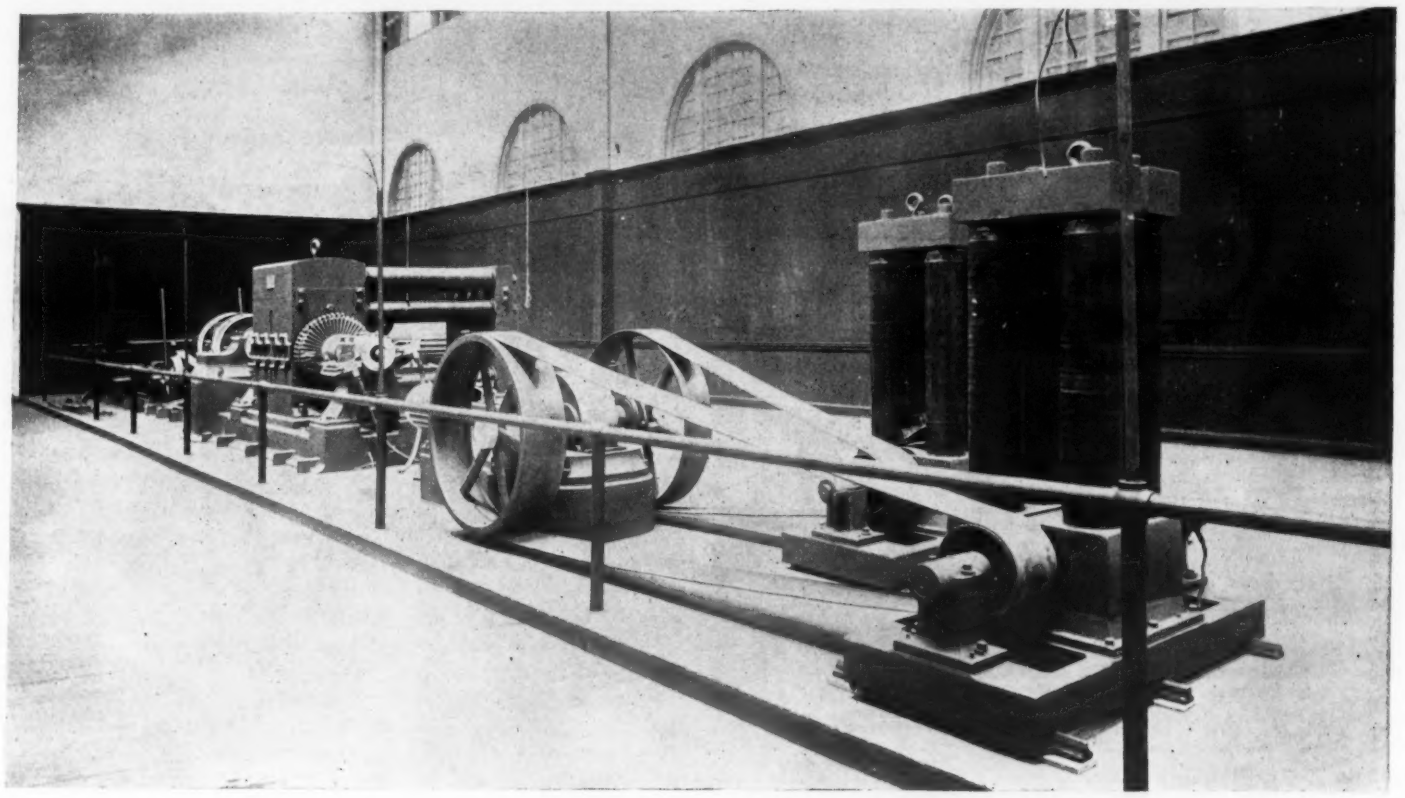


FIG. 5.—EDISON HISTORICAL EXHIBIT.

is across the aisle. The first Edison electric locomotive with its passenger car shows in a graphic way the progress in transportation made since 1880.

The photograph of the British section reveals the splendid display of electrical and scientific instruments made by the English manufacturers. Most of these instruments have been tested and have certificates from Lord Kelvin's laboratory or the National Physical Laboratory. The General Post Office makes an excellent display of the telegraphic apparatus used in Great Britain. Kelvin and

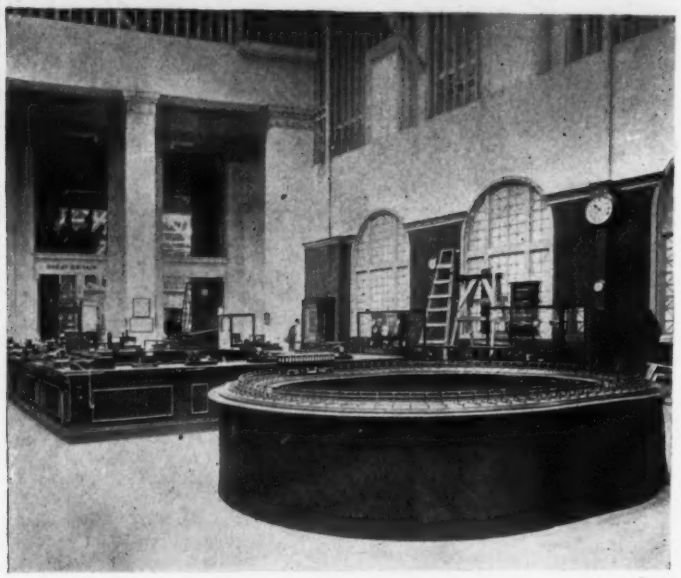


FIG. 6.—ENGLISH EXHIBIT.

James White, of Glasgow, and Muirhead & Co., of Kent, have cases of galvanometers, condensers, standard cells, ammeters, voltmeters and other instruments of precision. In the foreground may be seen a working model of Behr's monorail and high-speed car as authorized by act of Parliament for the railway between Manchester and Liverpool, to be operated at a speed of 110 miles per hour.

The greater part of the space of the Wagner Electric Company, of St. Louis, in Section 9, is occupied by the various applications of single-phase alternating-current motors. This includes the standard form, enclosed, semi-enclosed and back-geared types, from ¼ to 35 hp. The notable feature of these motors is their starting under

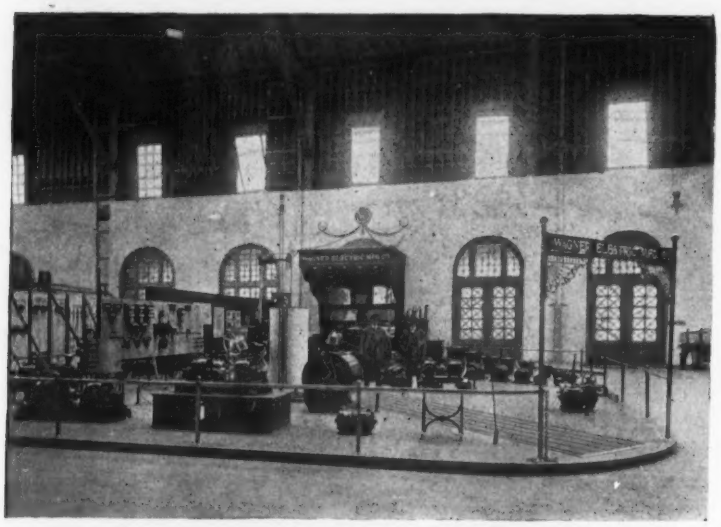


FIG. 7.—EXHIBIT OF WAGNER ELECTRIC MANUFACTURING COMPANY.

load by simply closing a switch. Such a simple starting arrangement makes the motors specially applicable to pumps for different kinds of service, carbonators, as used in drug and confectionery stores, and fans. The noiseless operation of the motors has won them a place for organ-glowing as applied to ordinary bellows in connection with a speed-varying pulley and special centrifugal pressure blower. Other industrial applications are shown in operation, such as machine tools, bakery machinery, etc. In this connection a special speed-changing device is exhibited whereby a machine tool with a single-phase alternating-current motor has all the advantages of control that it would have with a direct-current multivoltage drive. A standard line of transformers from 6/10 kw to 50 kw are shown, in different types of self-cooled, water-cooled and air-blast. A handsome five-panel switchboard is erected at one side, and carries a full equipment of instruments and oil-break switches made by the Wagner Company. Two of the panels are for the operation of the motors and the other apparatus in the exhibit. In the Wagner booth are many interesting photographs and diagrams showing the performance of the various types of machines. There is an office equipment and telephone connection with the down-town office, which are freely and courteously at the disposal of visitors.

The exhibits of electro-therapeutic apparatus are centers of interest to the visitors on account of the high-potential discharges and the X-ray demonstrations. One of the most attractive of these is that of W. Scheidel & Co., which is near the main entrance in Section 4. There is exhibited a complete line of standard X-ray coils, mercury turbine interrupters, Oudin resonators, rheostats, operating and coil tables complete with volt and ammeters, motor and primary rheostats, switches and split-second-stop watches, cab-

FIG. 8.—EXHIBIT OF W. SCHIEDEL & CO.

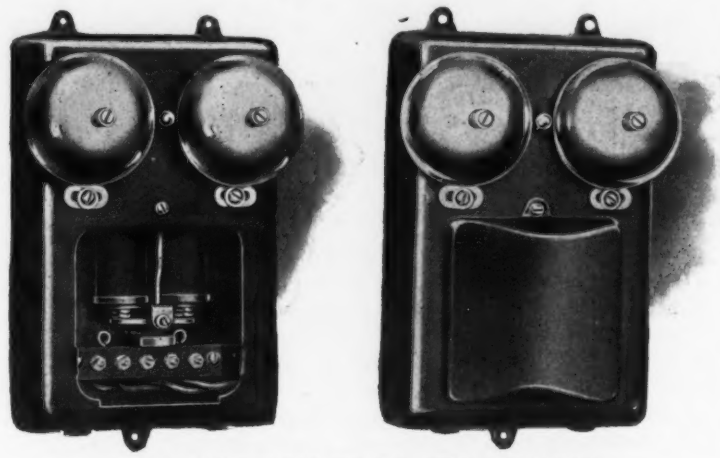
inets containing complete outfits, illuminating cabinets, various tubes, rectifying interrupters for transforming alternating current into direct-curent, fluoroscopes, storage batteries, tube stands, shields and electrodes for local and therapeutics treatments, and a large collection of photographs. Physicians and laymen alike are attracted by the high-potential, high-frequency currents produced by the Oudin resonator, which operates in conjunction with a Leyden jar. The alternating discharge of the jar may be at the rate of a million a second, but by placing a large resistance in the circuit the oscillations are dampened. In order to get from the oscillations of the Leyden jar circuit, currents of high frequency, three different types of machinery are used, namely, the hyperstatic, in which the therapeutic currents are of high potential and are produced by induction; the d'Arsonval spiral or coil, in which currents of low potential are shunted from the Leyden jar circuit by self-induction, and the Oudin resonator.

The resonator consists of a large helix of heavy copper wire, on the lower part of which are passed strong oscillating currents from Leyden jars, which are excited by a coil of sufficient capacity. The upper and longer portion of the helix is not traversed directly by these currents, but is thrown into electric vibration, in harmony with the oscillating currents in the lower part; and these vibrations have a much greater range than the original oscillations. The resonator is regulated by shifting the movable contact near the base of the coil, in front; by varying the rate of interruption of the primary current, and by varying the spark-gap of the resonator. This apparatus can be used as a substitute for static machines, and for Finsen light in the treatment of many forms of disease. All the Scheidel apparatus is connected for operation and a competent demonstrator is in attendance at all times.

Common Battery Telephones.

The Kellogg Switchboard & Supply Company, of Chicago, is constantly adding to and improving its telephonic apparatus, and we now illustrate its latest types of desk telephone and desk set box. In the desk telephone the tubular construction does away entirely with the unsightly wear or tarnish caused by handling the usual nickel-plated standard. The mechanism is dust-proof and cannot be tampered with as it is entirely enclosed.

A tubular standard and a hollow brass base support and contain all the parts of the stand. The transmitter is adjustably hinged to the top of the standard, and two cords, concealed their entire length, lead from it to their proper connections in the base. This base is



FIGS. 1 AND 2.—DESK SET BOX, OPEN AND CLOSED.

covered by a handsome nickel-plated brass shell, and in it are mounted a condenser, the hook switch, a retardation coil and two rubber terminal blocks for the receiver and desk stand cords. The condenser is of a special construction designed to give a comparatively large capacity in a small space. The retardation coil is also of an especially

FIG. 3.—DESK TELEPHONE.

compact design. All parts in the base are normally enclosed by an iron plate which fits over the bottom.

The lever of the hook switch is a long L-shaped piece pivoted on the standard, the short arm of which terminates in the fork for the receiver while the long arm extends down through the hollow standard to the base, where its insulated end engages with the hook spring switches. This lever is actuated by a stiff leaf spring.

The new type of Kellogg desk set box is also illustrated herewith open and closed. The compact box is shallow so that it may be mounted in any convenient place about a desk without being in the

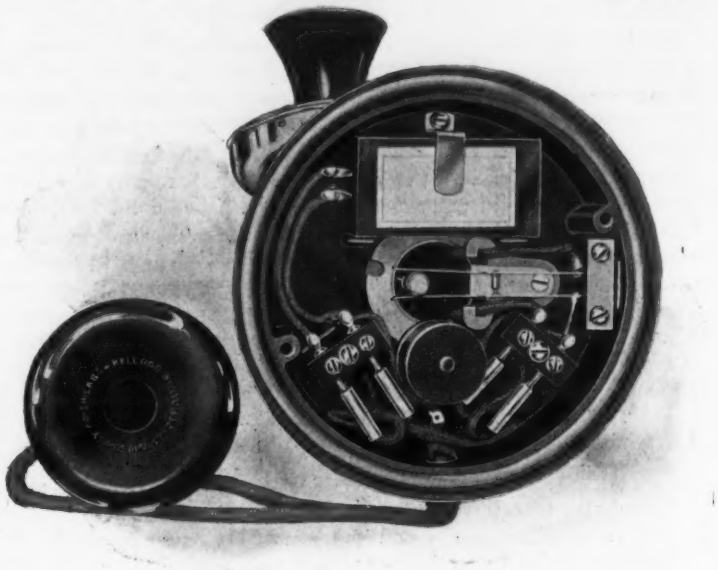


FIG. 4.—VIEW OF INTERIOR OF DESK SET BASE.

way. Standard parts are mounted in a pressed steel case, finished with black enamel. There are enclosing lids front and back, which when removed expose the ringer, condenser and connecting rack. It is intended for either individual or two-party line service and besides being in black is furnished also in white or maroon enamel.

Power and Mining Machinery Contracts.

The Power & Mining Machinery Company (formerly the Loomis-Pettibone Gas Machinery Company, of New York, and successor to the Holthoff Machinery Company, of Cudahy, Wis.), New York, has just been awarded a contract for the equipment of the new power plant of the Wellington Meat Export Company, a British capitalized concern, which operates a large works at Wellington, New Zealand. The value of the contract is almost $125,000. The existing power plant is operated by steam, and owing to the excessive cost of coal in that part of the world the installing of the gas generating equipment and electrical machinery, for which the Power & Mining Machinery Company has the complete contract, is expected to result in a saving of 75 per cent. in fuel.

There will be a 3,000-hp gas generating outfit comprising six generators of 500-hp capacity each, to operate on the Loomis-Pettibone system. Crossley two-cylinder horizontal gas engines will be installed. There will be nine engines aggregating in all 1,415 hp. Three will be of 225-hp capacity each, direct-connected to 150-kw, direct-current, 250-volt electric generators. There will also be two 200-hp Crossley engines, one 160-hp and also a 100-hp engine, which are to be used for driving refrigerating machinery. Gas generated by the same plant will also be used for the large melting and heating kettles. The entire power plant will be in full operation, it is anticipated, in December of this year. Mr. W. H. Morse, one of the Power Company's engineering experts, is now in New Zealand regarding the contract. The electric generators have not yet been purchased.

The Power & Mining Machinery Company will next week complete the installation of the largest power plant of its description in the hemisphere, at Velardena, in the vicinity of Durango, Mexico. The contract was secured from the Velardena Mining & Smelting Company, which concern is controlled by the Guggenheim Exploration Company, New York. The plant will have a capacity of no less than 3,000 hp and consists of five 600-hp Crossley two-cylinder horizontal gas engines to be belted to alternating-current electric generators of 350-kw capacity each. The electric generators were built by the General Electric Company. Power will be generated for transmission to a group of copper, silver and lead mines, including the famous Copper Queen property and the Teneras & Santa Maria mines. The transmission line is about 50 miles long. The voltage is 13,000.

A contract has been secured for the installation of a 300-hp plant for the purpose of lighting Newton, N. J. There will be two American Crossley two-cylinder horizontal gas engines of 200-hp and 100-hp capacity respectively. These machines are to be direct-connected to 150-kw and 75-kw alternating-current electric generators.

Convention of National Electrical Contractors' Association.

A special train will leave the Grand Central Station, New York, at 1 p.m. September 10, for St. Louis to convey the delegates to the fourth annual convention of the National Electrical Contractors' Association of the United States, which will be held in St. Louis September 14, 15 and 16. The train will arrive at St. Louis next evening at 6.45 o'clock. On account of the exceedingly low rates issued by the several passenger associations between St. Louis and other points it has been unnecessary to secure a special rate on the certificate plan for the benefit of delegates and visitors to the convention. The headquarters for the Eastern delegates will be at the Washington Hotel, which is within easy distance of the fair grounds. Mr. Alex Henderson, 527 West Thirty-fourth Street, New York, is master of transportation, to whom communications should be addressed.

Electrically Illuminated Roof Signs.

The desire to attract customers or to impress a firm's name or the character of a business on the inside of the public cannot be met better than with an electric roof sign, which, while it may cost from 50 cents to $5 an hour in operating expenses, is bound to be read by all the people who pass within a number of blocks, and, possibly, if it be a large sign, within a number of miles of the locality where the sign is placed.

The exposed position of such signs calls for solid metal construc-

ROOF SIGN.

tion. Such signs in all sizes have been designed and are constructed by the Haller Machine Company, of Chicago. The letters they make are indestructible and perfectly water-proof. The company is glad to furnish data as to what the operating expenses of such a sign would be. Any local electrician can connect the sign to service wires, and electric light companies are usually prepared to furnish low special rates for current for this purpose.

Underground Conduit Rods.

Since the original appearance of screw joint couplings many designs have been put upon the market and a new one is found in the "Security Conduit Rod."

The design is simple and not likely to get broken in a wagon or in a manhole. This is important, because the handling is severe. Made of iron they are not negotiable at junk yards. The joint with

CONDUIT RODS.

the wood is made by rivets holding large washers; the wood, being hickory, does not split easily, and there is no chance for a break. Coupling and uncoupling is done very quickly, and when in the duct there is no slack between joints, nor can they possibly uncouple, although they will lend themselves to moderate bends.

In weight they are light, and long runs can easily be handled by one man. The standard lengths are three and four feet. The rods are easily handled in manholes, quickly jointed and unjointed, and will stand abuse. The couplings lock together rigidly and the rods will not buckle under pressure nor bind against conduit walls. There is no slack between rods. These rods are the product of the Bissell Company, Toledo, Ohio.

A Large Transmission Cable Order.

The Mexican Light & Power Company, Limited, of Montreal, Canada, recently placed with the Ansonia Brass & Copper Company, 99 John Street, New York, an order for copper cable for transmission, which is probably the largest single order for transmission cable ever placed. The order calls for 1,500 miles of cable, equal in car-

FIG. 1.—SHOWING METHOD OF SPLICING.

rying capacity to 3/0 B. & S. gauge, and weighing approximately 4,200,000 pounds. The cable is to be used on the Nicaxia-Mexico power transmission line, now under construction, and it will be supported on steel towers in spans of 500 ft. The length of the spans, together with the necessity of reducing the dip as much as possible and the high wind pressure to be withstood, made the matter of cables one of considerable importance. The cable furnished by the Ansonia Brass & Copper Company was designed by Mr. W. G. Clark, of Seattle, Wash., electrical engineer. Mr. Clark found that the cable should have the highest possible elastic limit to withstand

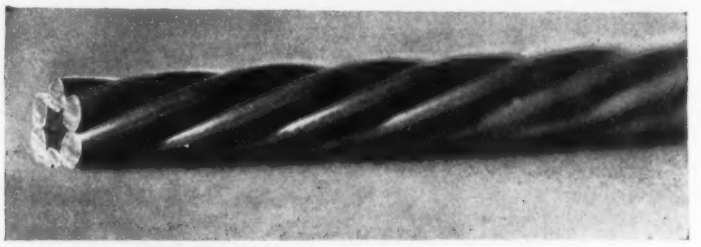


FIG. 2.—ELASTIC CENTERED CABLE.

the strain; high conductivity to reduce to a minimum the area exposed to wind pressure, high ductility to reduce the possibility of the strands breaking at the ties, and also that each length of cable should be made without splices in the strands to maintain an even temper and elongation; while the cable should be made in lengths as great as could be conveniently handled on the ground, and so designed that the strain should be evenly distributed between the constituent strands—each strand carrying its own portion of the load. A series of experiments demonstrated that while the ordinary

FIG. 3.—SPLICE OF ELASTIC CENTERED CABLE.

concentric laid cable did not meet these requirements, the cable designed by Mr. Clark met the conditions in a satisfactory manner.

The wires composing the cable receive a special treatment, both while the rod is being rolled and while the wire is being drawn. To secure a high elastic limit without sacrificing ductility and conductivity the cable is laid up of six wires around a soft compressible

center, which is compresed as the cable is laid up, and still further compressed when the cable is placed under tension on the line. As all the strands are of equal length, compressing the elastic core, the strain is evenly distributed between the strands. After the cable is stretched in position, the core is no longer of service, and may decay or be removed without affecting the even distribution of the load. The core is so compressed that the space taken up by it is of no importance, but it materially increases the flexibility of the cable, making it more convenient to handle during erection.

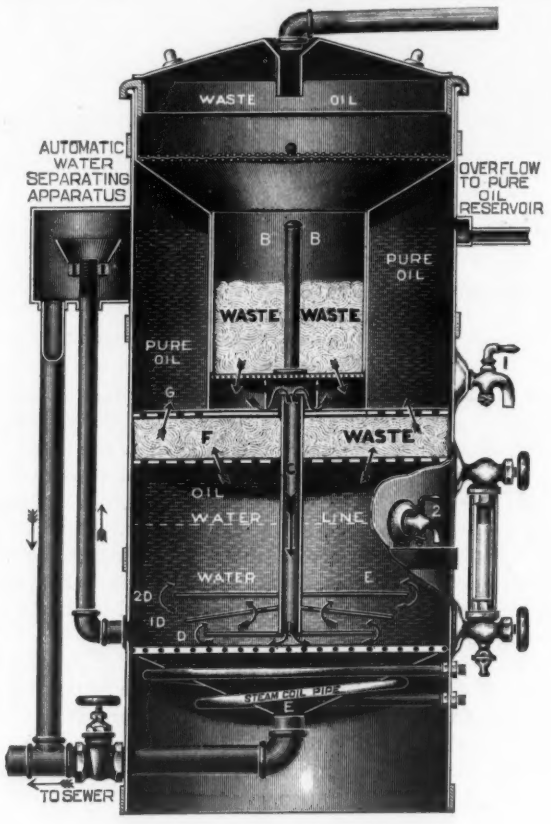
The splices in the line will be made by passing the ends of the cable through a copper tube, driving a taper pin in each end to replace the soft core, and then twisting the sleeve. A joint 12 in. in length made in this way shows one-fourth the resistance of an equal length of cable, and the wires are so firmly compressed into the copper tube that they are not affected by corrosion.

Some idea may be gained of the size of this order when it is considered that the cable, in a single length, would reach half way from New York to Seattle, Washington. The wires composing the cable, each almost as large as an ordinary lead pencil, would, if connected in a continuous length, reach entirely through the earth at the equator, with a thousand miles over; or would reach practically from New York to Manila. The reels required for shipping the cable would, if piled lying flat upon one another, make a pile 7,400 ft. high, or almost a mile and a half.

Oil Filter for Large Plants.

The Burt Manufacturing Company, Akron, Ohio, is the manufacturers of the oil filter shown in the accompanying sectional view, designed to receive the condensation from oil separators or exhaust heads and to automatically separate the oil from the water, while at the same time purifying it. The water is drained to the sewer and the pure oil, rising into a separate chamber, overflows into the pure oil reservoir. The filter is made in twelve different sizes, with filtering capacities of from 300 to 500 gallons per 24 hours.

The mixed oil and water is received through the inlet at the top of the filter and then passes through a layer of waste, which collects all the heavier impurities of the oil. Thence it passes through the



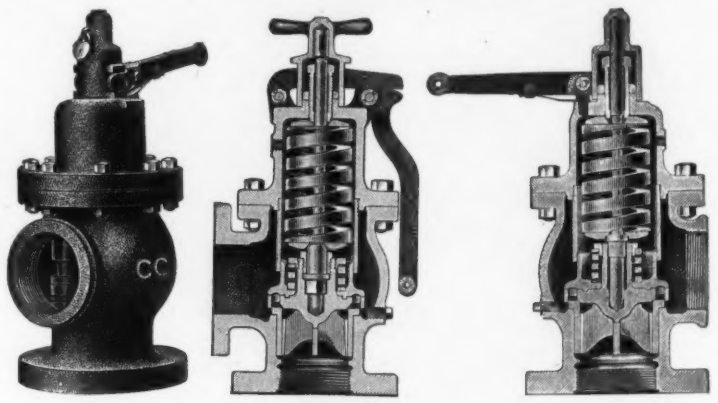
OIL FILTER.

perforations in the bottom of chamber B, following the course indicated by the arrows, into tube C, and from here on to the filter plate D. The increased weight of the water has a tendency to keep the oil back in tube C, but when the pressure of the oil in chamber B becomes sufficient the oil is forced down and spreads over the plate D in a very thin film. This constantly changes surface and grows thinner as it travels from the center to the circumference of plate D, thus exposing every particle of oil to the action of the water. It then flows on to plate 1D and 2D, going through the same process in each case. When the oil leaves the plate 2D it is in a finely divided state and is thoroughly washed by the water. It is separated from the water by gravity, and all the remaining impurities settle in chamber E, from which they can be drained to the sewer by opening the gate valve at the bottom of the filter. From the plate 2D the oil rises and again filters through F, another layer of waste, into the pure oil chamber, where it accumulates until it overflows into the oil reservoir. The water is automatically separated after it passes down the tube C and reaches the bottom plate, on account of its being heavier than the oil, and the surplus water passes into the pipe leading to the automatic water separating device.

Pop Safety Valves.

The constantly increasing demand for Crane patent "pop" safety valves has made it necessary for the Crane Company, Chicago, to increase the capacity of its manufacturing departments on these goods. It has also brought out a number of improved forms of pop valves for stationary, marine, locomotive and portable boilers; also a variety of cylinder reliefs, water reliefs, high-pressure and hydraulic relief valves for all purposes and pressures.

The construction of these valves embodies a self-adjusting feature which automatically regulates the "pop" of the valve or maintains the least waste of steam between the opening and closing points, an improvement which will be readily appreciated, as there is no necessity of re-adjusting to regulate the pop on changes in the set pressure.



POP SAFETY VALVES.

In all pop safety valves it is necessary to have a "pop" or "huddling" chamber into which the steam expands when the main valve opens, thereby creating an additional lifting force proportionate to this increased area and greater than the force of spring, thus holding the valve open until pressure is relieved. Means must also be provided to relieve this "pop" chamber of pressure, in order to allow the valve to close promptly and easily. This is accomplished by the self-adjusting auxiliary valve and spring, which are entirely independent of the main valve and spring. The steam in the "pop" chamber finds a passage through holes or ports into an annular space provided in the auxiliary valve or disc, and by reason of the light auxiliary spring this pressure lifts the auxiliary valve and allows the steam in the "pop" chamber to gradually escape, thus permitting a greater range in setting pressures with the least waste of steam and at the same time supplying a cushion or balancing medium, thereby preventing any chattering or hammering and affording the easiest possible action in closing.

The encased spring valves are constructed with a casing or chamber enclosing both springs, protecting them against the action of the steam, particularly high pressure, which, blowing with great force and velocity throughout all parts of valve before reaching the atmosphere, would otherwise have a tendency to disarrange the springs and other parts operating in connection therewith. This form of valve is also particularly useful where a number of valves may be connected to one main exhaust or discharge pipe. The encased spring chamber, extending over a greater portion of the top surface of the main valve, prevents any retarding action of the steam due to back pressure, which might be caused by one or more valves opening slightly in advance of another, in having any material effect on the free opening of the other valves.

Direct-Current Switchboard Instruments.

The accompanying illustrations show a line of direct-current switchboard instruments, possessing new and novel features in their design, and which have recently been adopted for use in many high-class installations where the best of everything is required.

Three general styles are shown, the principles of operation being the same in all, but the cases and general construction differing to conform to the requirements of service. The type shown in Fig. 2 is furnished with a round case, that of Fig. 2, with an illuminated dial, and Fig. 3 is an edgewise pattern having a narrow case as shown in the illustration. All cases are dust-proof and their appearance is ornamental in effect.

In shape, size and general appearance, the instruments of Fig. 1, known as type D, correspond with the other round pattern switchboard instruments manufactured by Westinghouse Electric & Manufacturing Company. The scale is longer than that of any other similar instrument, and the divisions, which are spaced uniformly throughout, are large and open. The instrument shown in Fig. 2, known as type E, has two tabular lamps, which are so arranged in a separate ventilated compartment as to give a uniform distribution of light over an opal glass scale 20 in. in length.

The width of the cases in the edgewise pattern, known as type H, is only 5¼ in. This permits more instruments to be mounted side by side than is possible with the round pattern, when space is limited. The angle or position of the scale and the large open markings facilitate accurate readings.

In construction, these instruments combine a strength which will enable them to withstand rough usage, and a sensitiveness necessary for reliable indications. The magnetic system consists of two permanent horseshoe magnets bolted to a pair of parallel soft-iron pole pieces, the lines of magnetic force passing across the air-gap between the upper and the lower pole pieces. Enclosing the upper pole piece, but not touching it, is a movable coil of fine wire wound around an oblong aluminum bobbin. This coil is attached to the framework of the movement and its weight is just sufficient to counterbalance the weight of the pointer. This construction allows a very long scale and also permits the removal of the movement without taking off the magnets. The indications are dead-beat.

The pole pieces are attached to the permanent magnets before they are magnetized and aged and there is, therefore, no possibility of the magnetic condition being disturbed in assembling or repairing. They are kept in stock for a long time after the treatment is finished and any magnets which upon final test show change of magnetic properties, are rejected.

The controlling springs are not supported by the movement as is usual in other instruments, but are mounted on stationary brass rods in the ends of which the sapphire jewels are set. This arrangement materially reduces the weight on the pivots and in conjunction with the light weight of the moving element (which is made entirely of aluminum) and the excellence of the bearings, in which pointed steel pivots rest in the finest sapphire jewels, free the instruments from any influence by friction.

The ammeters operate from shunts made from resistance metal having a very low temperature coefficient and arranged for connection to the bus-bars. A record of the resistance of each is kept on file as well as sent with each meter, so that when an ammeter is to be calibrated or replaced by a new one, it is not necessary to disturb the bus-bars. In order to calibrate one of these ammeters, it is only necessary to connect a portable millivoltmeter in parallel across the same shunt.

Electric Automobile Charging Panel.

The wide application of storage batteries as a source of power for electric trucks and automobiles, has brought forward the matter of battery protecting devices best suited to the requirements of this class of service. On the manner in which the storage battery is handled, largely depends the successful or economic service of the electric vehicle. If the battery is charged at too high a rate—that is, the charging current is too great—the plates of the battery are destroyed; while a discharge of the battery under abnormal conditions will also cause serious damage to the battery. Careful attendants, guided by suitable measuring instruments, will minimize these dangers, but what is desired is an automatic device which will protect the battery in case of any abnormal condition.

FIGS. 1, 2 AND 3.—DIRECT-CURRENT SWITCHBOARD INSTRUMENTS.

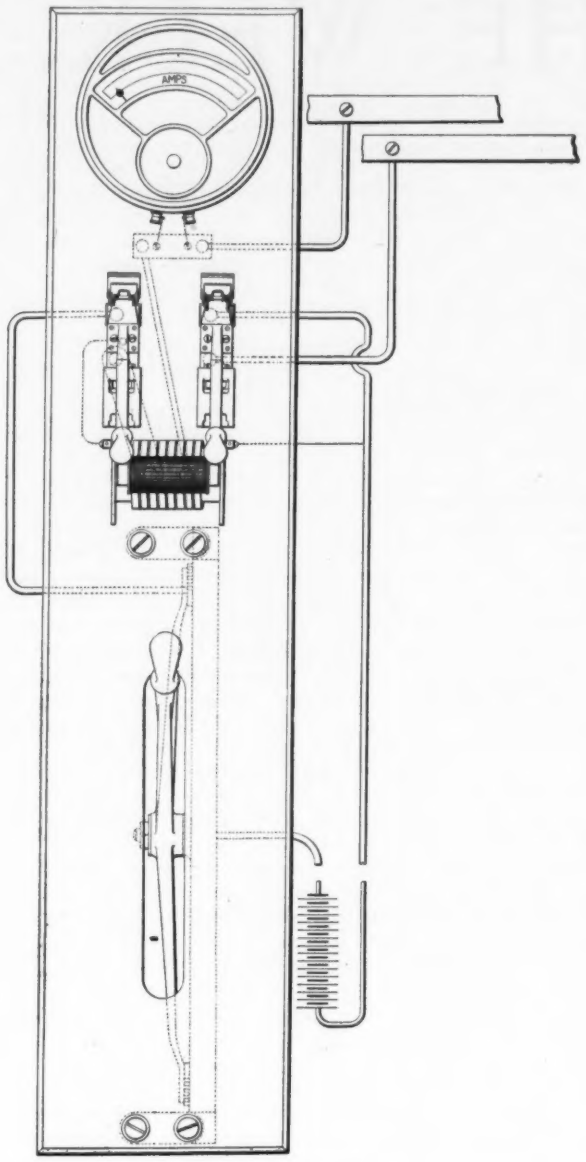
The accompanying illustration is of a standard electric automobile charging panel; on it is mounted an ammeter, a rheostat and an overload and reverse-current circuit-breaker of the "Dublarm" type, which acts as a combined hand switch and circuit-breaker.

The ammeter shows the current flowing into the battery and can be supplemented by a voltmeter which would show the voltage; but, where a number of these panels are used, one voltmeter on a swinging bracket at the end of the board usually serves for all the feeders. The rheostat in series with the line varies the voltage of the charging circuit and in that way allows the charging current to be either increased or diminished as required while the battery is being charged.

The circuit-breaker acts as the main feeder switch, and is so designed that it automatically opens the circuit the instant the charging current exceeds an allowable amount. It is provided with a calibrated scale, which can be adjusted so that the circuit-breaker will open at any desired current, and also automatically open in case the current should flow from the battery into the charging circuit, which would discharge the battery and possibly ruin the plates. Both the overload and the reverse current features are absolutely positive in their operation.

This circuit-breaker is made by the Cutter Company, of Philadelphia, and is one of their "Reversite" types, which have been very largely used by the United States Navy for the protection of storage batteries used in connection with their naval telegraph

equipments. They are also used extensively for the protection of



CHARGING PANEL.

storage batteries in telephone exchanges, and are made single, double and triple-pole in any capacity to meet the various requirements.

Measuring Currents in Cables.

A simple apparatus for measuring the current at any point of a cable and thereby determining the load on a feeder or at a point of a distribution network, is shown in the accompanying illustrations, the apparatus being made by the General Electric Company. It consists of a special transformer having a hinged magnetic circuit and a standard Thomson inclined coil ammeter.

The magnetic circuit of the transformer is of specially treated iron thoroughly laminated and accurately machined. Special attention has been given to the hinged and clamping joints so as to insure the best possible magnetic path. The former is provided with a strong and easily manufactured locking device, which insures a uniform and positive contact. The transformer windings, which are placed on either arm of the hinged magnetic circuit, are of 5 amp. capacity and designed to withstand 2,300 volts potential between the windings and core. High insulation is secured by winding the coils on heavy insulation wrapped around the hinged iron core, and is further safeguarded by thoroughly impregnating the windings with a special insulating compound.

In order that the serviceableness of the testing outfit may be further increased, flexible duplex leads 40 ft. in length are supplied with each set. The transformer can thus be clamped in position around the conductor and the ammeter removed to a more convenient place for reading. The ammeter is constructed so as to withstand the hard usage to which portable instruments are subjected. Each instrument is provided with an armature locking device, which, when the instrument is not in service, lifts the pivots from the jewels and prevents damage to these parts. In order that accurate and rapid read-

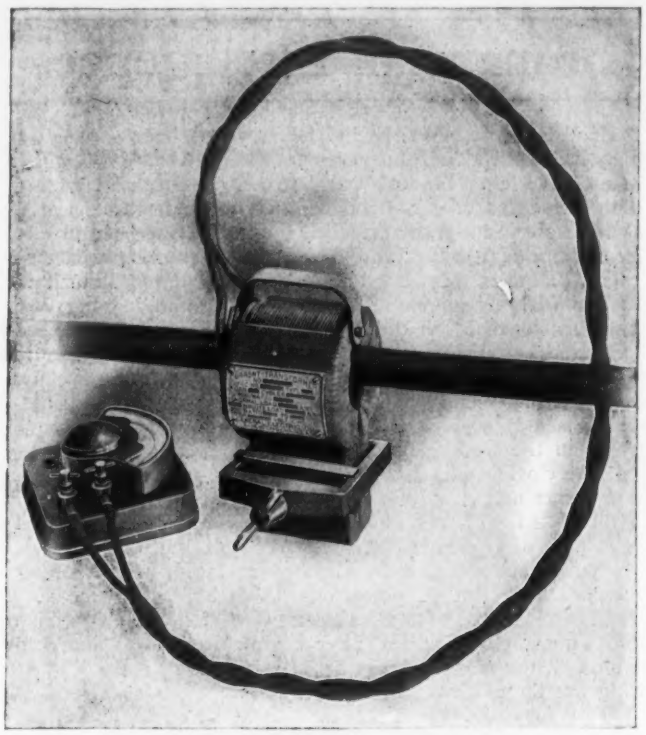


FIG. 1.—TRANSFORMER WITH PORTABLE AMMETER.

ings may be taken, the instrument is provided with a damping device, which enables the indicating pointer to be brought quickly to rest after each change of current. The scale is satisfactory as to length, legibility and distribution—a fact of much importance in making tests covering wide ranges of current.

When a test is to be conducted the terminals of the duplex leads

FIG. 2.—TRANSFORMER OPEN.

should be inserted in the ammeter binding posts and the transformer jaws firmly clamped in position around the cable. The transformer will maintain within commercial limits its ratio accuracy from one-eighth load to 25 per cent. overload. The combined weight of the transformer and ammeter is about 25 pounds.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was extremely dull with alternating periods of depression and slight rallies on short covering. Trading was narrow, the inactivity of business and the unsettled crop outlook tending to create some bearishness. Features were lacking, the principal trading having been in the Steel shares, Consolidated Gas and Erie, with alternating weakness and strength. Reports were heard that Brooklyn Rapid Transit is likely to show largely increased earnings during the summer, but they had no visible effect on that stock. Amalgamated Copper was the object of a certain amount of trading, but with negative results. Among the industrials, Allis-Chalmers common kept steady at 6 throughout the week, which figure was also the closing price. Preferred closed at 39¾, a net gain of ¼ point. General Electric lost 2 points in the week's trading, the prices ranging between 153 and 156¼, the closing quotation being 155. Westinghouse made a gain of 1⅛ points net, closing at 156⅛. The traction stocks were firmer and all closed with net gains. Brooklyn Rapid Transit closed at 46⅜, a gain of ⅝ point; Metropolitan Street Railway at 111, a gain of ¼ point, and Manhattan Elevated at 142½, a gain of 1 point. Western Union lost ¾ point, closing at 87¼. Outside securities were heavy as to prices and transactions were limited. Interborough Rapid Transit closed at 112, after having declined to and recovered from 106⅜, the closing figure being a net gain of 4½ points. Following are the closing prices of May 24:

NEW YORK.

	May 17	May 24		May 17	May 24
Allis-Chalmers Co.	6¼	6⅛	Electric Vehicle	4⅜	5⅛
Allis-Chalmers Co. pfd.	40	39⅛	Electric Vehicle pfd.	9	9
American Tel. & Cable	86¼	87	General Electric	154	156
American Tel. & Tel.	123	125	Hudson River Tel.	..	..
American Dist. Tel	22	22	Metropolitan St. Ry.	110	110⅛
Brooklyn Rapid Transit	45⅜	46⅜	N. Y. & N. J. Tel.	..	..
Commercial Cable	180	180	Marconi Tel.	..	..
Electric Boat	26	25	Western Union Tel.	87	86⅛
Electric Boat pfd	60	60	Westinghouse com.	153¼	155
Electric Lead Reduction	⅝	⅝	Westinghouse pfd.	175	180

BOSTON.

	May 17	May 24		May 17	May 24
American Tel. & Tel	124	125	Western Tel. & Tel. pfd.	77	77
Cumberland Telephone	113¼	113	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	234	234	New England Telephone	*123	*121¾
General Electric	152	155	Mass. Elec. Ry.	17⅛	18
Western Tel. & Tel.	8	*7	Mass. Elec. Ry. pfd.	69⅛	70⅛

PHILADELPHIA.

	May 17	May 24		May 17	May 24
American Railways	44⅛	44⅛	Phila. Traction	96	95¾
Elec. Storage Battery	55	55	Phila. Electric	5½	5⅛
Elec. Storage Battery pfd.	55	55	Phila. Rapid Trans.	*13⅛	12¾
Elec. Co. of America.	8	8			

CHICAGO

	May 17	May 24		May 17	May 24
Central Union Tel.	..	..	National Carbon pfd.	102	101¾
Chicago Edison	..	..	Metropolitan Elev. com.	15	16
Chicago City Ry.	155	156	Union Traction	5¼	5⅛
Chicago Tel. Co.	..	..	Union Traction pfd.	29	29
National Carbon	29	29			

*Asked

BOSTON EDISON.—A Boston dispatch to the *Wall Street Journal* says: "By the payment May 2 of the final instalment on its new stock, the Edison Company has taken up about $500,000 of its notes, leaving at present $1,000,000 still outstanding. These notes are of various maturities, the longest being for a year, and the latter bearing a 4 per cent. interest rate. Additional notes of about $1,000,000 will be issued between now and next winter, when a 10 per cent. new stock issue will be made, which will clean up the entire floating debt. The Edison Company has not yet taken over the electric business of the Woburn Electric Company, owned by interests friendly to the former company. The electric business of the Chelsea and Newton & Watertown gas and electric companies also has not been taken over. These companies are owned by interests representing the Edison Company and Massachusetts Gas Companies. With the Bay State gas suit now settled, it is expected that early action will be taken to assimilate these properties, the gas business in each instance going to the Massachusetts Gas Companies and the electric business to the Edison Company.

KINLOCH TELEPHONE IN ST. LOUIS.—It is stated that financial arrangements have been completed by the Kinloch Long Distance Telephone Company of Missouri with a St. Louis banking syndicate, whereby it, together with other leading independent companies of the country, will be enabled to perfect a trans-continental long-distance system. The Kinloch Co. will shortly file a first mortgage deed of trust to the Mississippi Valley Trust Company, of St. Louis, trustees, covering all of the suburban and interurban properties embraced in the long-distance service. The deed of trust will secure an issue of $5,000,000 first mortgage 5 per cent. 25 year old gold bonds, dated 1904 and maturing in 1929, and the specific purpose of the mortgage is to provide additional capital for extra outlays needed for additions, extensions and other like improvements. It is the intention to eventually gridiron the southwest with lines and with the co-operation of half a dozen of the largest companies not allied with the American Bell Telephone Company, a powerful organization is expected.

COLORADO TELEPHONE.—The Colorado (Bell) Telephone Company reports as follows for the year ending December 31, 1903, and preceding years:

	1903.	1902.	1901.
Gross	$1,294,837	$1,083,037	$858,820
Expenses	977,733	771,231	625,956
Net	$317,104	$311,806	$232,864

The company's capital stock on December 31 was $4,153,000, an increase of $753,550 over 1902. The number of subscribers stations is now 30,226, an increase of 6,753 over 1902. Of the expenditures of $977,733, $289,211 or 29.6 per cent. was charged to maintenance. The American Telephone and Telegraph Company on June 30 last owned $1,744,250 of the $3,400,000 capital stock or 51 per cent.

NEW ENGLAND TELEPHONE.—The New England Telephone and Telegraph Company will in all probability issue additional stock this summer for new construction. It has been the custom of the company for several years to issue additional stock annually, but the rule was broken last year, as the financial conditions were not propitious for a new stock issue and the company was well provided with funds. The growth of the company's business, averaging about 15,000 new subscribers annually, requires about $2,000,000 new capital each year for new construction. For the first three months of this year there were 4,000 new subscribers added, making total subscribers March 31, 130,138. The last new stock was issued in June, 1902, stockholders being offered 36,047 new shares at par on the basis of one new share for each five owned.

THE CALIFORNIA GAS AND ELECTRIC CORPORATION held its annual meeting in San Francisco on April 3. The first monthly dividend of 25 cents per share was declared payable May 16. It was decided to set aside $1,000,000 for betterments and extensions during the coming year. Additional electrical machinery will be installed to operate the Sacramento Electric Gas and Railway Company's system. A large amount will be expended on improving the Standard Electric transmission system, which was recently acquired. An additional 4,000-kw generating unit will be installed this summer at the De Sabla power station.

NIAGARA FALLS POWER REPORT.—The Niagara Falls Power Company reports as follows for the six months ended December 31, 1903: Gross, $579,550; net, $481,060; other income, $37,296; total net, $518,356; surplus after charges, $144,416; improvements, betterments, etc., $42,199; surplus, $102,217. Fixed charges, taxes, etc., include interest for six months on $10,000,000 first mortgage bonds, and on the 6 per cent. debentures issued for the construction of power house No. 2 and one-half of all taxes for the year. Surplus for the six months amounts to about 4 per cent. on the outstanding stock.

NORTH AMERICAN IN ST. LOUIS.—The Laclede Gas Light Company sold recently to N. W. Harris & Co., $4,000,000 5 per cent. 30-year bonds, which has enabled it to pay off the short time notes issued a few months ago, besides giving abundant funds for all purposes. N. W. Harris & Co. sold the entire issue, mostly in the West, before the bonds could be engraved. The North American Company now has its new power plant at St. Louis practically completed, the engines having been installed, and is ready to furnish power to the St. Louis car lines.

CHARLESTON GAS AND ELECTRIC.—The Consolidated Railway Gas and Electric Company, of Charleston, S. C., for year ended February 28, 1904, showed gross $538,173, and surplus after expenses, fixed charges, sinking fund, etc., $22,161.

SOUTHERN ILLINOIS TROLLEYS.—It is stated in Chicago dispatches that the Southern Illinois Electric Traction Company has voted an increase in capital stock from $50,000 to $2,000,000. An extensive system of electric railroad is to be built in the vicinity of Mount Vernon, Ill.

MISSOURI BELL TELEPHONE.—The Bell Telephone Company of Missouri has been given authority to increase its capital from $4,000,000 to $10,000,000 for the extension of its business and system.

BUYING WIRELESS PATENTS ABROAD.—A cable dispatch from London states that a syndicate represented by Charles J. Glidden and E. Bertram Newton, of Boston, have purchased the rights to use the Armstrong-Orling wireless telegraph and telephone patents in the United States and Republic of Mexico. This system has been illustrated and described in our columns. Mr. Glidden is a veteran telephone manager and financier, prominent formerly in the Erie Telephone & Telegraph Company.

BONDS FOR POWER PLANT.—The St. Joseph and Elkhart Power Company has filed a mortgage of $1,750,000 to the New York Security and Trust Company, to secure a bond issue.

Commercial Intelligence.

THE WEEK IN TRADE.—Complaint is still heard of unseasonable weather, trade and the crop situation being affected thereby. According to reports received by the mercantile agencies cool weather is responsible for the slow distribution of spring and summer goods at retail, and the retardation of germination and growth of crops, though permitting good progress in seeding in various sections of the country. In jobbing circles there appears to be a feeling that the spring trade is past, and efforts are now being concentrated on fall business. The industrial situation is somewhat quieter. The strike of masters and pilots of lake vessels continues, with no prospect of settlement. This has had a serious effect on lake transportation. No expansion is indicated by bank clearings, which are considerably behind those of last year. Railway earnings show losses as compared with last year. For the first half of May the decrease in gross is about 4 per cent., and the same percentage of loss is shown for the entire month of April. For the first three months of the year gross earnings are about 1 per cent. less than last year, and net receipts are about 15 per cent less. Money is still easy, but collections are backward. The iron market showed most pronounced weakness, declines ranging from 25 to 50 cents per ton. Among the finished products bar iron is lower at the west, but steady at the east. The other metals are all weaker, copper being dull and heavy at a slight decline. Two hundred and fifteen business failures during the week ended May 16 are reported by *Bradstreet's*, an increase of 14 as compared with the previous week. During the corresponding week last year the number was 155.

BELL TELEPHONE OUTPUT.—The instrument statement of the American Telephone & Telegraph Company for the month ended April 30 and since December 20 is as follows:

	1904.	1903.	1902.	1901.
Gross output	102,907	104,429	108,242	72,396
Returned	42,335	43,491	37,587	33,177
Net output	60,572	60,938	70,655	39,219
Since December 20:				
Gross output	404,475	410,390	387,795	288,505
Returned	151,325	160,137	152,085	122,604
Net output	253,150	250,253	235,710	165,901
Total outstanding	4,032,667	3,400,573	2,761,720	2,118,717

The above statement shows a net output of 60,572, bringing the total number of instruments outstanding for the first time in the company's history above the 4,000,000 mark. The number outstanding on April 30 was 4,032,667, which compares with 3,779,517 outstanding at the close of 1903. The extremely rapid growth of the Bell system apparently shows no signs of let up. The growth in the four months ending April 30, as shown by the net output of 253,150 instruments, is equal to 6½ per cent., or at the rate of 2 per cent. a year. If this rate is continued, the system will have 4,500,000 instruments outstanding by next December. Five years ago the system had 1,125,000 instruments outstanding, and ten years ago it had less than 600,000. The increase in five years has amounted to nearly 300 per cent.; and in ten years to nearly 600 per cent. It will of course be understood that the number of instruments has to be divided by two to get at the actual number of stations.

HUGE PLANT FOR PHILADELPHIA WANAMAKER STORE.—The new Wanamaker department store under construction in Philadelphia is to be equipped with one of the largest, if not the largest, isolated electric lighting plant in this country. While no definite details are available at the moment, it can be said that the capacity will be not less than 3,000 kw. The boilers have already been contracted for with the Babcock & Wilcox Co., New York. The boiler capacity will be 5,300 hp. The Philadelphia store has been designed by D. H. Burnham & Co., of Chicago. Charles Wilks, the Burnham Co.'s chief engineer, is now engaged in drawing up the plans for the electric plant. The contracts for equipment will in all probability be awarded through H. D. Babbit, the electrical engineer of the Thompson-Starrett Co., which concern will construct the building. Mr. Babbit is an old Chicago Edison man. The new Wanamaker store being built between Eighth-street and Broadway, New York, by the same contractors, is to have an 1,800 kw plant, Westinghouse generators and Buckeye engines having been ordered last month. Figures on the Philadelphia plant are expected to be taken in about a fortnight.

INSULATED WIRE FOR JAPAN.—The Safety Insulated Wire and Cable Company, 114 Liberty Street, New York, has received a contract from the Japanese Government contracting firm of Oki & Co., Tokio and Yokohama, for a very large lot of rubber insulated wire. The Artillery Corps, which arm of the United States army has just taken over the submarine mining and coast defense work from the engineering corps, has contracted with the Safety Insulated Wire and Cable Company for a big lot of torpedo cable. The Artillery Corps headquarters are at Willets Point, N. Y. Captains Bailey and Parker are the senior officers. The company has also been awarded the contract for laying the Commercial Cable Company's land cable between Coney Island and 20 Broad Street, New York.

CONTRACT LET FOR 1,000 H. P. MEXICAN HYDRAULIC PLANT.—The electrical engineering and contracting firm of Ugarte & Garcia, Guadalajara, State of Jalisco, Mexico, whose representative, Mr. Ugarte is now in the State, being at the time of writing in St. Louis, has secured a contract for the construction and equipment of a water-power plant of 1,000 hp capacity. The equipment will include three alternating-current generators of 250 kw capacity each for direct connection to water turbines. The transmission line will be about 15 miles long. The equipment, etc., will be manufactured in the United States and the plant is expected to be in running order inside of 12 months.

FEEDER CABLE, ETC., FOR MANILA.—The electrical engineering and contracting firm of J. G. White & Co., New York, which concern has the contract for the construction and equipment of the extensive electric lighting and traction system now being hastened to completion on behalf of an American syndicate at Manila, has awarded contracts for a big lot of triple braid weather-proof feeder cable to the Holmes, Booth & Haydens Co., New York, while the Magnet Wire Company, New York, secured the substantial order for the bare magnet wire.

EQUIPMENT FOR HENRY HEIDE ADDITIONAL PLANT.—An extensive addition is to be made to the candy manufacturing plant of Henry Heide, at Vandam and Hudson streets, New York, which will be equipped with a large-sized electric plant. Mr. C. O. Mailloux, New York, will act as consulting expert regarding the matter while Mr. C. J. Goldmark, of New York, will be the electrical engineer. Plans are now being drawn up and figures will be taken next month.

EQUIPMENT FOR CENTRAL PARK APARTMENTS.—The equipment to be installed in the addition of the Central Park apartment house at Seventh Avenue and Fifty-eighth St., N. Y., has been ordered. There will be a 450-hp outfit. Mackenzie, Quarrier & Ferguson, 114 Liberty Street, secured the contract, which calls for three 150-hp Harrisburg engines direct-connected to General Electric generators of 100-kw. capacity each.

EQUIPMENT FOR NEW BUENOS AYRES THEATRE.—A large electrically operated heating, ventilating and cooling system is to be installed in the $2,000,000 Colon Theatre building now under construction at Buenos Ayres, Argentine Republic. The contracts will be placed in the United States through the export commission house of Kates & Bok, Orient Building, Wall Street, New York.

EQUIPMENT FOR PORTO RICO SUGAR PLANTATION.—M. G. F. Tremain, 135 Broadway, New York, has secured a contract for a Robb-Armstrong engine, built by the Robb Engineering Company, of Amherst, Nova Scotia, for belting to a generator. The outfit will be used for light and power purposes on a large sugar plantation located in the vicinity of Mayaguez, Porto Rico.

EQUIPMENT FOR MICHOACAN MINES.—The Carrizal Gold Mining Company which operates extensive mines in the State of Michoacan, Mexico, will shortly let contracts for the construction and equipment of a fair-sized electric plant. Mr. S. L. Butler, of Salt Lake City, Utah, is president of the company.

BIG STORAGE BATTERY OUTFIT FOR MEXICO.—The Compania Minera de Penoles which Mexican concern operates extensive mines at Mapimi, State of Durango, already equipped with considerable American electrical machinery, is about to install a large storage battery outfit for the smelter plant.

NICARAGUAN POWER TRANSMISSION.—The Siempre Viva Mining Company, of Bluefields, Nicaragua, Central America, is having plans drawn up by Wallace C. Johnson, consulting engineer, Niagara Falls, N. Y., for the construction of an extensive power transmission system.

EQUIPMENT FOR ERIE BASIN IRON WORKS.—The Erie Basin Iron Works, which are controlled by the Krawjenski-Pesant

Co., sugar machinery manufacturers, New York, is to be equipped with considerable electrical equipment, including an alternating-current crane.

THE FIBRE CONDUIT COMPANY, Orangeburg, N. Y., reports that between April 1, 1903, and April 1, 1904, the number of orders received has increased nearly 300 per cent., and the month of April, 1904, is the largest April in the history of the company, including orders from Electrical Commission of Baltimore, Md.; Edison Electric Illuminating Company, of Brooklyn, N. Y.; General Electric Company; Merchants' Heat & Light Company, of Indianapolis, Ind.; Cazenovia Light & Power Company, of Cazenovia, N. Y.; Westinghouse Electric & Manufacturing Company; Suffolk Light, Heat & Power Company, of Southampton, N. Y.; United States Naval Academy, of Annapolis, Md.; Edison Electric Illuminating Company, of Detroit, Mich.; Morton F. Plant, of Groton, Conn.; Citizens' Telephone Company, of Grand Rapids, Mich.; Edison Electric Illuminating Company, of Boston, Mass.; Public Service Corporation, of New Brunswick, N. J.; W. M. Sheehan Company, of New York City; Telluride Power Company, of Provo, Utah. Most of the above companies are old customers, and it certainly speaks well of the product to have them come back every year. The Telluride Power Company at Provo, Utah, is building an underground conduit system for its 60,000-volt circuits and sent its representative East to investigate with the result that its entire order was placed for fibre conduit. The Electrical Commission in Baltimore has used approximately half a million feet and still continues to send orders.

SOME HARRISBURG ENGINE ORDERS.—Mackenzie, Quarrier & Ferguson have secured a contract for a 125-hp Harrisburg standard engine for direct connection to a 75-kw. Crocker-Wheeler generator as additional equipment for light and power purposes in the Philadelphia plant of the Pennsylvania Salt Company. Ten 125-hp Harrisburg standard engines have also been ordered for direct connection to 75-kw. Northern generators. This equipment will be installed in the Twenty-third Regiment Armory, Brooklyn, for lighting purposes. A 75-hp Harrisburg standard engine direct-connected to a Crocker-Wheeler generator has been ordered as an additional unit for the State Normal School at Trenton, N. J. Among foreign contracts in hand is one for a 100-hp Harrisburg engine which is to be belted to a 62½-kw. generator of General Electric build for shipment to Newcastle, Australia.

STERLING ELECTRIC COMPANY, Lafayette, Ind., has just received large orders for telephones from the following cities: Hudson, N. Y.; West Liberty, Iowa; Redkey, Ind.; Ossian, Ind.; and Cedar Rapids, Iowa—the latter for its four party line selective type of telephones. It is installing its latest type of combined distributing boards and protectors at Ames, Iowa; Caro, Mich., and Sully, Iowa. It has also contracted for a 500 tubular drop, bell type switchboard for Eaton, Ohio. It has also received orders for various switchboards and additions for Monticello, Ind.; Brandenburg, Ky.; Mattoon, Ill., and Galena, Kan. In addition to this, it has received large orders for its various types of protectors for Kansas City, Mo.; Peru, Ind.; Pittsburg, Pa.; Hudson, N. Y., and Lyons, Iowa. It has been recently reported that the Sterling Company is receiving orders for condensers of its manufacture at a rate of 5,000 a day.

ELECTRIC POWER FOR DIAMOND MATCH COMPANY.—The Diamond Match Company, which is building several large factories in and near Chico, Cal., has closed contracts through the Wagner-Bullock Electric Company, of California, for three alternating current generators to supply electric power for operating woodworking machinery. There will be three generating units, each consisting of a Bullock generator direct connected to an Allis-Chalmers automatic engine. Sterling boilers will be installed in the power station. The distance of transmission will be short.

THE S. H. COUCH COMPANY, of Boston, Mass., has recently closed several contracts for telephone equipment, among which are the Lafayette Hotel, Portland, Me., which calls for 140 telephones and a 140-line common battery board of its new target type. This replaces a previous equipment recently installed. Also orders for common battery boards for Worcester City Hospital, Worcester, Mass., replacing present system, and Hartford Carpet Corporation, Thompsonville, Conn., and a magneto board for Medfield Insane Hospital, Medfield, Mass.

WALRATH GAS ENGINES FOR PORTUGAL.—The Marinette Gas Electric Company, of Chicago Heights, Ill., has secured a contract for five double cylinders Walrath gas engines for direct connection to generators. This contract came from Portugal. The equipment will be used for lighting purposes. A 75-hp three-cylinder engine direct-connected to generator was recently shipped to Lisbon, Portugal, for installation in the building occupied by the Bank of Portugal where several other Walrath engines are installed.

EQUIPMENT FOR LIMA LIGHTING PLANT.—The Compania Santa Rosa, Limitada, which concern lights Lima, Peru, is to extend considerably its water power plant. The General Electric Company has taken the order for the generator, which is to be of 800-kw capacity. The water wheels will be shipped by the Pelton Water Wheel Company, which has also taken an order for 2,100 ft. of 60-in. pipe. The existing equipment consists of three 400-kw General Electric generators and Pelton wheels.

THE EDISON ELECTRIC COMPANY, of Los Angeles, Cal., has recently placed an order with the Abner Doble Company, of San Francisco, for two 800-hp, 176 r.p.m. impulse water-wheels, two 40-hp exciter wheels, and two type F Lombard governors. These wheels will be installed in the Edison Company's Santa Ana River No. 2 plant near Redlands, and will operate under a 305-foot head. They will be connected to General Electric 750-volt three-phase generators.

LARGE SWITCHBOARD EQUIPMENT.—The H. Krantz Manufacturing Company, of Brooklyn, has secured the contract for the switchboard, etc., to be installed in the electrical plant of the Metropolitan Life Building, Madison Square, New York. There will be no less than 156 Dublarm type circuit-breakers, combination switch and circuit-breakers on the board. It will be the largest installation of its description hitherto contracted for.

THE AUTOMATIC ELECTRIC COMPANY, of Chicago, is now installing 4,000 automatic telephones and complete switching equipment for the Home Telephone Company of Los Angeles, Cal., and 1,200 for the Auburn Telephone Company, Auburn, N. Y. It has received orders for the equipment of San Diego, Cal., with 1,200 automatic telephones, and Lewiston, Me., with 1,500.

WESTERN ELECTRIC COMPANY'S NEW PLANT.—The Falkenau Construction Company has been awarded the contract for the erection of some more new buildings at the Western Electric Company's plant at Hawthorne, near Chicago. The principal building will be for the insulating plant and will be 401 x 200 ft. The total cost, with other lesser structures, will be about $142,000.

THE WIRT ELECTRIC COMPANY, of Philadelphia, has moved into its new factory at 3108 Germantown Ave., the change being rendered necessary by its rapidly increasing business. The new plant is commodious, well planned, and affords the company every facility for turning out high-class work promptly.

EQUIPMENT FOR HOTEL RENAISSANCE.—The Hotel Renaissance, West Forty-third Street, New York City, is to be equipped with two 100-hp Harrisburg standard engines direct-connected to 60-kw, 125-volt General Electric generators. The outfit will be used for both light and power purposes.

NEW HARMONIE CLUB TO TAKE STREET CURRENT.—There will be no plant installed in the first instance in the new Harmonie Club to be built in East Sixtieth Street, New York, as power will be taken from the street. C. O. Mailloux is the consulting engineer.

LIGHTING PLANT FOR BRAZIL.—The export commission house of Agar, Cross & Co., New York offices Bowling Green Building, representing the Westinghouse interests in Brazil, has been awarded a contract for the construction of a plant which is to light Rio VI.

EQUIPMENT FOR MEXICAN CARRIAGE FACTORY.—Electrical equipment is to be installed in a large carriage factory about to be constructed by Noake & De Smeth, Chihuahua, State of Chihuahua, Mexico.

RHODESIAN LIGHTING PROJECT.—A municipal electric lighting system is to be installed in Salisbury, Rhodesia, South Africa. Mr. Crawford Lindsay is the consulting engineer. Salisbury has a population of about 15,000 people.

EQUIPMENT FOR MEXICAN CONCENTRATOR.—Electric power is to be substituted for gas power for generating energy to operate the 450-ton concentrator plant of the Tecoletes Company, at Santa Barbara, Mexico.

HEINE BOILERS FOR WILKESBARRE.—The Wilkesbarre & Wyoming Traction Company, of Wilkesbarre, Pa., has placed a contract for a 1,500-hp boiler outfit with the Heine Safety Boiler Company, New York offices Bowling Green Building.

ELECTRIC DRILL GRINDERS FOR SOUTH AFRICA.—The Wilmarth & Moorman Company, of Grand Rapids, Mich., has secured a substantial contract for electrically-driven drill grinders for export to South Africa.

MORE EQUIPMENT FOR HENDERSON, KY., PLANT.—The plant of the Henderson, Ky., Street Railway is to be enlarged. The boiler order has just been let to the Heine Safety Boiler Company, of St. Louis.

ELECTRICAL SUPPLIES FOR CUBA.—The Robb-Mumford Boiler Company, New York, has two good-sized orders in hand for electrical supplies for shipment to Havana.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—According to a report just issued by the Home Telegraph & Telephone Company, its earnings for the quarter ended April 1 were $74,698.59 and operating expenses $47,881.08, leaving the net earnings for the quarter $31,817.51. This amount, together with $5,029.61, gives a total of $36,847.12 available for dividends or improvements. The number of instruments installed up to April 1, 1904, was 12,026. During the previous six months 3611 were put in and during the last quarter 1551 were reported.

SPRINGFIELD, ILL.—The Calhoun Telephone Company, of Hardin, Ill., has increased its capital stock from $15,000 to $25,000.

WATSEKA, ILL.—The Fountain Creek Telephone Company has been incorporated with a capital stock of $24,000. G. H. Weil is president.

BELLEVILLE, ILL.—A mortgage has been filed in Belleville by the Kinloch Long Distance Telephone Company to the American Trust and Savings Bank, Chicago, and George W. Galbreath, of St. Louis, for $5,000,000.

MONROVIA, IND.—The Monrovia Telephone Company has incorporated to build an exchange and telephone lines in Morgan and Hendricks counties. The capital stock is $2250. W. H. Hubban is president.

DELPHI, IND.—The New Co-operative Telephone Company organized in this (Carroll) county will be known as the Flora and Bringhurst Co-operative Telephone Company. The company will put in an entirely new system. Dr. W. E. Callam is president and A. G. Crosswhite, secretary.

SPENCER, IND.—The Farmers' Mutual Telephone Association has been incorporated to operate in Owen, Monroe, Morgan, Putnam, Clay and Greene counties. The capital stock is $10,000. John S. Snodgrass, John Smith, E. F. White and S. H. Alverson, are the incorporators.

BLOOMINGTON, IND.—The Bloomington Home Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is placed at $150,000. The company will establish an exchange and system of telephones and lines in Bloomington and Monroe County. J. D. Showers, W. D. Bradfute, E. L. Barber and Q. C. Mentieth are the directors.

ELKHART, IA.—The Elkhart Mutual Telephone Company has been incorporated with $10,000 capital stock.

KEOKUK, IA.—The Iowa Telephone Company has secured a lot in this city and will soon erect a building for its exchange.

WEST UNION, IA.—The Rogers Telephone Company has been incorporated with a capital stock of $25,000. The directors are C. H. Talmadge and others.

LOUISVILLE, KY.—The Deatsville & Solitude Telephone Company has been incorporated in Nelson County with a capital stock of $800.

BALTIMORE, MD.—The ordinance granting the Maryland Telephone & Telegraph Company the right to use the streets for electric light and power wires has passed the council and has been signed by the Mayor.

GRAND RAPIDS, MICH.—The Cranmoor Telephone Company has been incorporated with a capital stock of $2000. The directors are J. B. Arpin, M. O. Potter and others.

ROTHSAY, MINN.—The Rothsay Telephone Company has been incorporated with a capital stock of $10,000.

ST. LOUIS, MO.—The Bell Telephone Company, of Missouri, has been granted authority to increase its capital stock from $4,000,000 to $10,000,000. The company will improve and extend its lines throughout the State.

RED LODGE, MONT.—The supreme court of Montana, in a recent decision, held that the city council could not restrain the Rocky Mountain Bell Telephone Company from erecting poles and string wires in the city, provided the company gave the city the privilege of designating where the poles should be placed.

HARDY, NEB.—The Hardy Telephone Company has been incorporated with a capital stock of $10,000.

ARAPAHOE, NEB.—The Arapahoe Independent Telephone Company has been incorporated with a capital stock of $20,000.

RENO, NEV.—Linemen have started from Tonopah on the construction of a telephone and telegraph line to Goldfields. Poles have already been distributed, and no time will be lost in carrying the line to completion.

KEESEVILLE, N. Y.—The Keeseville Telephone Company has been incorporated with a capital stock of $20,000. The directors are J. H. A. Bond, J. B. Mace, and others.

BINGHAMTON, N. Y.—The Whitney's Point and Glen Aubrey Telephone Company has been incorporated with a capital stock of $1000. The home office will be in Glen Aubrey.

LEONARD, N. D.—A telephone company has been organized here with Richard Piper as president.

BEREA, OHIO.—The Citizens' Telephone Company has increased its capital from $40,000 to $50,000. H. E. Bolles is president.

STRYKER, OHIO.—The Stryker Telephone Company has increased its capital stock from $10,000 to $15,000 and is planning improvements to its system.

MT. VERNON, OHIO.—The Mount Vernon Telephone Company, capital $150,000, has been incorporated by J. E. Russell, W. C. Curtis, O. M. Arnold and others.

ROCK CREEK, OHIO.—The Covell Telephone Company, of this place, will build a line to connect with the exchange at Jefferson. The Covell company is building farmers' lines throughout this district.

PERRY, OHIO.—The Perry Telephone Company, capital stock $10,000, has been incorporated by F. E. Morrison, W. R. Child, J. H. Brown, E. W. Orcutt and others to build an exchange at Perry.

SUMMERFIELD, OHIO.—The Summerfield Telephone Company, of Noble County, has been chartered with $10,000 capital stock by Wm. Simmons, E. S. Wilson, H. R. McClintock, C. H. Dew, J. H. Sparling and others.

CLEVELAND, OHIO.—All of the telephone operators employed by the Cuyahoga Telephone Company on May 1 received an advance in salary about 8 per cent. President Dickson, it is stated, had the matter under contemplation for several months and strongly advocated better salaries for the employees.

CLEVELAND, OHIO.—The United States Telephone Company has closed a contract whereby after July 1 it will have an interchange of business with the National Telephone Company, of Wheeling, W. Va. The lines of the Flushing and Belmont telephone companies have been leased and these with about 25 miles of a new line will give the desired connection.

MORRISON, OKLA.—The Perryman Telephone Company has been incorporated with a capital stock of $2000. The directors are J. T. and L. Perryman and others.

ENID, OKLA.—The Garland Mutual Telephone Company has been incorporated with a capital stock of $1000. The directors are H. C. Davis, R. H. Smith and others.

ALTOONA, PA.—The Highland Telephone Company has been formed to establish a telephone line in Summerhill and Cambria townships.

ANDERSON, S. C.—The Anderson Telephone Company, manufacturer of instruments, has increased its capital stock from $16,000 to $30,000. G. W. Evans, W. R. Osborne and others are the directors.

ALPENA, S. D.—The Alpena Telephone Company has been incorporated with a capital stock of $5000.

TAYLORSVILLE, TENN.—The Smith County Telephone Company has been organized in this city and capitalized at $5000.

MEMPHIS, TENN.—The Western Union Telegraph Company has completed plans and specifications for the extension of its underground system in a large section of the up-town district in this city. The cost will be about $20,000.

COVINGTON, TENN.—The Cumberland Telephone Company has withdrawn its service from Covington a tax of $1.50 per pole having been placed on it by the city. The Memphis Telephone Company will install an exchange in place of the Cumberland.

LYTLE, TEX.—The San Antonio & Lytle Independent Telephone Company has completed its telephone line from San Antonio to Lytle.

WEBB, TEX.—The Gertie Webb Telephone Company has been incorporated with a capital stock of $20,000. J. H. Miller, A. M. Fowler and others are the directors.

DEXTER, TEX.—The Dexter & Gainsville Telephone Company has been incorporated with a capital stock of $2000. The directors are J. F. Morris, D. D. Thorn and others.

TYLER, TEX.—D. A. Walker, of Columbus, Ohio, and associates, have purchased the exchanges of the Tyler Telephone Company and the Globe Telephone Company of this place. The exchanges will be enlarged.

SEYMOUR, TEX.—The Proffitt Telephone Company, of this city, has filed letters of incorporation, with a capital stock of $40,000. The incorporators are J. W. Proffitt, John H. Proffitt, of Proffitt, W. E. Hayner and W. E. Bailes, of Seymour.

HOUSTON, TEX.—The Phoenix Telegraph & Telephone Company has been organized with principal office in this city for the purpose of building and operating telephone lines in a large number of counties of the Northern and Eastern parts of the State. The incorporators are J. M. Smith, Lorenzo Hills and A. L. Hills.

FILLMORE, UTAH.—The Millard County Telegraph & Telephone Company has been incorporated with a capital stock of $6000. Mr. Thomas A. Callister is president.

ORFORDSVILLE, WIS.—The Orfordsville Telephone Company has increased its capital from $10,000 to $15,000.

MILWAUKEE, WIS.—The Old Dominion Telephone Company, of Roanoke, Va., has been incorporated in this State.

HALIFAX, N. S.—A combination of the Nova Scotia Telephone Company, the Eastern Telephone Company, and other companies has just completed a telephone system 293 miles long. It runs from Halifax to Cape Porcupine via Truro, New Glasgow and Antigonish. Connection is made over the strait of Canso by a submarine cable, the line then runs to Sydney direct. A branch runs from Aulds Cove to Mulgrave and another from Port Hastings to Hawksbury. Connection has also been made with the Sherbrooke Telephone Company at Antigonish and with lines running to St. Peters and Narricht at Port Hawksbury; at Orangedale with Marble Mountain and Baddock and at Sydney with North Sydney, Synod Mines, Glace Bay and Lewisburg. Over 100,000 pounds of copper wire and between 13,000 and 14,000 cedar poles were used in the construction. The cost of building the line was nearly $100,000 and a rate has been struck at $1.25 for a three-minute conversation between 8 a. m. and 6 p. m., and 65c. for the same time between 6 p. m. and 8 a. m.

ZAMORA, MEX.—A telephone line is being built between this place and Chavinda.

OPICHEN, MEX.—A new telephone line is being constructed between this place and the town of Colentur, in this State (Yucatan).

CULIACAN, MEX.—A company is being organized here for the purpose of installing a new telephone exchange and to build and operate long distance lines throughout the State. Governor Francisco Canedo can give information.

CULIACAN, MEX.—A report has been made by the state Government of Sinaloa showing that there are 1058 miles of telephone lines in operation in the State. A new telephone lines has been constructed between the port of Topolobampo and the town of El Fuerte, along the Kansas City, Mexico and Orient Railroad.

ELECTRIC LIGHT AND POWER.

SYLACAUGA, ALA.—The citizens have voted to issue $20,000 electric light and water bonds.

WYLAM, ALA.—There is some talk of constructing an electric light plant and water works here.

FLAGSTAFF, ARIZ.—The Flagstaff Electric Light Company contemplates installing a 60 or 75-kw generator with engine to correspond.

SEBASTOPOL, CAL.—G. W. Swain has secured a franchise for an electric light plant.

SAN FRANCISCO, CAL.—The Mutual Electric Light Co. has called a meeting of its stockholders for June 21 to vote an issue of $400,000 bonds, $250,000 to be sold for improvements and the remaining $150,000 to be held in treasury until such time as needed.

DENVER, COL.—The Colorado Power & Irrigation Company has secured a location on Grand River and has done some work on the intake and dam site. The company proposes to install two plants, the main plant having a capacity of 15,000-hp and a small auxiliary plant of 5000-hp. No contracts have yet been made for the machinery. Electric energy will be transmitted about 100 miles for mining, lighting, metallurgical processes and irrigating. It will be one year yet before the necessary stone and other construction work at the plant is completed.

WATERBURY, CONN.—The New Milford Power Company, which transmits electric power from its plant at Bulls Bridge on the Housatonic River to Waterbury for consumption by the Connecticut Railway & Lighting Company in this section has had to change all the glass insulators on the double line of aluminum wires and substitute porcelain insulators. Much more satisfactory results are now obtained. The transmission line is being extended to the Cheshire and New Britain districts, where the Connecticut Railway & Lighting Company is erecting distributing stations.

WASHINGTON, D. C.—Bids are wanted May 28 for furnishing and delivering at the Library of Congress incandescent electric lamps, hardware, plumbing and electrical supplies, etc. Address Bernard R. Green, superintendent.

TAMPA, FLA.—A special meeting of the stockholders of the Tampa Electric Company has been called May 30, 1904, to consider the advisability of an increase in the capital stock of the company by the amount of $100,000.

THOMASTON, GA.—The question of constructing water works and an electric light plant is under consideration. Ira E. Farmer is mayor.

POST FALLS, IDA.—The Washington Water Power Company, of Spokane, Wash., has decided to install a power plant here, and Clemens Herschel, of St. Paul, has been engaged to outline plans for developing power both from Spokane and Post Falls. The plant will have a capacity of 10,000 horse-power. The power will be used to operate the Coeur d'Alene electric railways and for the operation of numerous Coeur d'Alene mines.

ST. CHARLES, ILL.—Some improvements are planned for the municipal electric light plant in this city. They will include a 350-hp Corliss engine and one 160-kw generator. These improvements will be made during the summer.

NEW HAVEN, IND.—The town board has rejected all bids received for constructing an electric light plant here. Bids will be readvertised for at once. J. M. Jackson is town clerk.

PERU, IND.—It is proposed to construct a dam, electric power plant and an electric railway between Vincennes and West Baden. Jerome Herff, of Peru, can give further information.

MOORESVILLE, IND.—The Public Service Company is advertising for bids for the construction of the power-house for the water works and electric light plant. The plans and specifications are ready for distribution among applicants.

ELKHART, IND.—A mortgage for $1,750,000 has been filed by the St. Joseph & Elkhart Power Company, covering the immense power plant recently built on Hen Island, in the St. Joe River. The mortgage was filed for the benefit of the New York Securities and Trust Company, and is to take up an old mortgage and to secure enough money to carry out important and extensive improvements. The company has increased its capital stock from $50,000 to $250,000. Ernest A. Sanders is president.

BURLINGTON, IA.—The Merchants' Light & Power Company has been incorporated to construct an electric light plant. The capacity of the new plant at the outset will be 20,000 lights. The work of construction and installation of the plant will be under the supervision of Sweet & Caster, electrical and mechanical engineers, of Burlington.

NEW ORLEANS, LA.—It is stated that contracts are about to be let by the Consumers' Electric Company for its electric plant. It will cost complete about $1,000,000.

GLOUCESTER, MASS.—The Gloucester Electric Company intends to install a 500-kw. steam turbine.

SOUTH STILLWATER, MINN.—Bids are wanted May 28 for an electric light plant. J. J. Flather, Minneapolis, is the engineer, and B. L. Hanks the recorder.

CLARKSDALE, MISS.—A dynamo of 350 or 400-kw capacity, a boiler and a switchboard are to be installed in the municipal electric light plant in this place.

SALISBURY, MO.—A 100-kw alternator and one 200-hp boiler are to be installed in the municipal electric light plant in this place.

JOPLIN, MO.—A proposition will be voted upon June 6 next to appropriate $30,000 for the improvement of the municipal electric light plant in this city. If it carries, a 250-kw generator, engine and boiler will be installed.

LAMAR, MO.—The Lamar Light & Water Company will probably exchange all of its present machinery for larger units or install a duplicate of what apparatus it now has. The present plant is overloaded and there is a large demand for more lights.

VERSAILLES, MO.—Sealed proposals will be received at the office of the mayor until June 3 for furnishing material and equipment for a complete electric lighting plant in this city. Plans, specifications and instructions are on file at the office of A. G. Baker, secretary Board of Public Works, Versailles, Mo., and W. K. Palmer, Consulting Engineer, 402 Lyceum Building, Kansas City, Mo.

FREMONT, NEB.—The question of enlarging the electric light plant is under consideration.

RENO, NEV.—Reno is to have two water and power companies. Work on the opposition plant begins at once and will be completed before the summer is ended. Governor Sparks is the principal owner of the new enterprise and has announced that the people of Reno would have an opportunity to secure water or light from his company not later than next spring. The company owns water rights on Hunter Creek, five miles north of the city.

NIAGARA FALLS, N. Y.—The Niagara Falls Hydraulic Power & Mfg. Company contemplates building a new power house.

SAG HARBOR, L. I., N. Y.—Bonds to the amount of $24,000 have been sold, to be used for building and equipping an electric light plant.

SYRACUSE, N. Y.—Architect A. Russell, 321 Bastable Building, will soon have plans complete, ready for bids for a power plant for the new court house.

NEW YORK, N. Y.—The contract for the electrical apparatus for the New York Navy Yard, for which bids were opened April 23, has been awarded to the General Electric Co., of Schenectady, for $43,500.

SHELBY, N. C.—The electric light plant in this place is to be rebuilt and the system changed to three-phase. Messrs. A. W. McMurray and Hugh G. Miller are the owners.

BAINBRIDGE, OHIO.—A dynamo is to be installed at the electric light and water works.

BELLEFONTAINE, OHIO.—The entire rebuilding of the municipal electric light plant in this city is contemplated.

BELLAIRE, OHIO.—The Bellaire Light & Power Company will expend about $75,000 in improvements.

NAPOLEON, OHIO.—Bids are wanted June 7 for $25,000 electric light and water bonds. Address F. W. Hilgendorff, Village Clerk.

WILLIAMSBURG, OHIO.—Chas. Hoffman, City Clerk, writes that bids for constructing an electric light plant and town hall will be received about June 1.

ZANESVILLE, OHIO.—The city authorities are considering the advisability of installing electrical apparatus in their present water works pumping station and generating their own lighting current. At present the city pays $20,000 per year for lights.

EATON, OHIO.—The Eaton Public Service Co. has been incorporated, with a capital of $200,000. It is to absorb the electric light, power and ice companies and will establish an artificial gas plant and a heating system. H. J. Philips, C. S. Glass and J. R. Cook are among the incorporators.

LA GRANDE, ORE.—J. K. Romig, manager of the Sanger mills, has announced that during the spring his company will install a large power plant at that point.

PORTLAND, ORE.—The Washington Water Power Company is perfecting plans to increase the capacity of its plant fivefold, thus giving the city plants 70,000-hp. The estimated cost of the new work is estimated at $1,500,000.

MAHANOY CITY, PA.—The Economy Light, Heat & Power Company has applied for a charter to furnish electricity for light, heat and power in Mahanoy City, Mahanoy Township and Delano Township. Harrison Ball and John Matthias, of Mahanoy City; P. D. Jones, of Hazleton, and F. P. Spiese, of Tamaqua, are among the incorporators.

CLINTON, S. C.—The City Council is considering the proposition of Washington capitalists to construct an electric light plant and water works.

CHATTANOOGA, TENN.—An electric plant of 200 horse-power has been built to drive the $50,000 addition to the Sheland Machine Works at Chattanooga.

BURLINGTON, VT.—Plans are about to be prepared for the municipal electric light plant to cost about $58,000.

NORFOLK, VA.—R. B. Fentress has petitioned for a franchise for a light, heat and power plant.

OLYMPIA, WASH.—The Olympia Light & Power Company has secured a franchise from the city council for extensive alterations and extensions to its street car lines.

VANCOUVER BARRACKS, WASH.—Bids will be received until June 9 by F. G. Hodgson, Ch. Q. M., Vancouver Barracks, for constructing an electric lighting system at this post.

SEATTLE, WASH.—The Citizens' Light & Power Company has been granted a permit to extend its system in this city at an estimated cost of $50,000. The Seattle Lighting Company is also contemplating extensions of its system in different sections of the city.

RICHWOOD, W. VA.—The Richwood Light & Power Company proposes to purchase a 125-hp engine, one 150-hp boiler and a dynamo.

ANTIGO, WIS.—The station of the Antigo Electric Light & Power Company was destroyed by fire May 5. The loss is reported to have been $20,000.

SUN PRAIRIE, WIS.—The Sun Prairie Electric Lighting Company contemplates the construction of 12 miles of transmission line.

MITCHELL, ONT.—About $10,000 will be expended for improvements to the water works and electric light plant. Jas. Barnett is town clerk.

STAYNER, ONT.—Mr. Joseph Knox, owner of the electric light plant, intends to develop water power for electric lighting and power purposes. The transmission line will be 6 miles in length.

THE ELECTRIC RAILWAY.

JASPER, ALA.—The Jasper Water, Light & Power Company has been granted a franchise to operate an electric railway here. J. M. Crawford is manager of the company.

HARTFORD, CONN.—The contracts for the construction of 39 miles of the proposed electric line between Hartford and Worcester have been awarded. The general contract has been given to James F. Shaw & Company, of Boston; the contract for boilers and similar material to Thayer & Company, of Boston, and the contract for turbines to the General Electric Company. The engineers are Sheaf & Jaastad, of Boston. The present expectation is that the work of construction will be undertaken about July.

AKRON, IND.—The Wabash & Rochester Traction Company has decided to locate the power house in this city. The survey of the line and the work of constructing the power house are to begin soon.

INDIANAPOLIS, IND.—The Chicago & Northern Indiana Railroad Company has been incorporated here to build an electric line from this point to Chicago. Lester Soule, president of the Globe Construction Company, of Des Moines, is promoting the financial arrangements.

FORT WAYNE, IND.—It is said that there is a deal pending for the merger of the Fort Wayne Traction Company, the Fort Wayne & Southwestern Traction Company and the local electric light and power company, which also has the franchise for steam heating in Fort Wayne. The sale is being negotiated through John White. The new company is to construct a monster generating station, using the exhaust steam for heating the downtown districts. Eastern capital is helping to complete the deal.

WATERLOO, IA.—The officers of the Waterloo & Cedar Falls Rapid Transit Company have announced a change of name to the Waterloo, Cedar Falls & Northern Railway.

WASHINGTON, IA.—The Arnold Electric Power Station Company, of Chicago, has reported favorably on the construction of the Iowa City, Kalona & Washington Electric Railway. The report recommends 30 miles of single track and 3 miles of turnouts and switches, with one power house and three sub-stations.

WATERLOO, IA.—It is said that surveys are to be begun at once for the proposed electric railway from Des Moines to Waterloo. The principal promoters are Indiana men, but a local office has been opened here, in charge of W. W. Marsh, Thomas Cascaden, J. E. Sedgwick, Geo. E. Litchy and F. J. Fowler, of this city.

FRANKFORT, KY.—Articles of incorporation have been filed by the Columbia & Lebanon Interurban Railway Company, of Marion County, which has $1,000,000 capital stock. The company will build 46 miles of electric railway, from Lebanon to Columbia. The principal office of the company will be located at Lebanon. The incorporators are W. K. Azbil, of Columbia; R. W. Wathen, J. M. Knott and T. M. Estes, of Lebanon; L. C. Rawlings, of Bradfordsville, and W. W. Bradshaw and C. S. Harris, of Columbia.

SPRINGFIELD, MASS.—The street railway committee of the Legislature has gone over the route of the proposed electric railway from Lee to Westfield, and it is reported will make a favorable report on the project.

HUDSON, MASS.—The Hudson & Northboro Street Railway Company has been given a franchise for the construction of a line that, by connecting Hudson and Northboro, will furnish a short route between Hudson and Worcester.

NORTHBRIDGE, MASS.—The Selectmen of Northbridge have granted a franchise to the Uxbridge & Blackstone Street Railway Company to extend its line from its present terminus at Linwood to Plummer's, there to make connection with the Worcester & Blackstone Valley Street Railway.

ANN ARBOR, MICH.—A company is being organized for the purpose of building an electric railway from Ann Arbor to Lakeland, and possibly to Brighton. Detroit capitalists are interested and are investigating the question as to the right of way. It is proposed to utilize the old mill dam at Hamburg, long unused, for the purpose of securing the necessary power.

GRAND RAPIDS, MICH.—The West Michigan Interurban Railway Company has been incorporated under the laws of Michigan with a capital stock of $1,000,000, for the purpose of building an electric railway from Grand Rapids to Park, Oceana County, by way of Muskegon. F. A. Nims, of Muskegon, and J. K. Flood, of Hart, are among the incorporators. E. H. Christ, of Grand Rapids, is the chief engineer.

SPRINGFIELD, MO.—The Western Traction Company, of Indianapolis, has commenced a survey between Springfield and Carthage for its proposed line.

NEW YORK, N. Y.—The New York & Port Chester Railroad Company has filed with the County Clerk its plans for a 25-mile four-track electric railroad from 132d St. to the State line beyond Port Chester. It is to cost $16,000,000.

SCHENECTADY, N. Y.—The statement is made that the General Electric Company is to equip part of the Schenectady Railway Company's system for experimenting with the single-phase system.

NEW YORK, N. Y.—The Bronx Traction Company has been incorporated with a capital of $585,000. The company is formed as a result of the consolidation of five street surface railroad companies in Bronx Borough, known as the Suburban Traction Company; Van Nest, West Farms and Westchester Traction Co.; Wakefield & Westchester Traction Company; West Farms & Westchester Traction Company and the Williamsbridge and Westchester Traction Company. The directors of the new corporation are Edward A. Maher, of the Union Railway Company; Henry A. Robinson, of the Metropolitan Street Railway Company; Charles E. Warren, D. B. Hasbrouck, D. C. Moorehead, of Brooklyn; Frank S. Gannon, Oren Root, Jr., Reune Martin and M. G. Starrett, of New York City. Edward A. Maher is president of the Consolidated Company and Thomas W. Olcott, secretary and treasurer.

NEW YORK, N. Y.—As an offset to the proposition of the New York City Railway Company to give free transfers between its surface lines and the next rapid transit subway, if built by the Metropolitan, the Interborough Rapid Transit Company has formed a combination with the Schmidt & Gallatin moving platform syndicate to interchange transfers from the elevated or subway lines to a platform subway under Thirty-Fourth Street. According to the plan of the combination, the Thirty-Fourth Street crosstown connection from Ninth to Second Avenues, if made possible of construction, will be followed by like moving platform subways through Grand, Twenty-third, Fourteenth and Fifty-Ninth Streets, to connect the elevated and subway lines. The latter proposition covers the original route suggested by the moving platform people—over the Williamsburg Bridge, with a loop to the Battery—and then urges the second route across Thirty-fourth Street. This, it is argued, will afford relief to the congestion that will be caused when the Pennsylvania Railroad tunnel station is ready for use.

CHARLOTTE, N. C.—The construction of an electric car line from High Point, N. C., to Greensboro is likely to assume definite shape. A. L. Garrell, owner of several lines, is at the head of the movement.

COLUMBUS, OHIO.—Ralph Peters, superintendent of the Pennsylvania lines (steam) in this district, is quoted as saying that the Cincinnati & Muskingum Valley Railway is to be equipped with electricity between Trinway and Lancaster, in order to compete with electric lines that are building and contemplated.

TOLEDO, OHIO.—The Detroit, Monroe & Toledo Short Line has commenced giving regular service between Toledo and Detroit. The through trip can be made in three hours, and the fare is 90 cents. This completes the connection between the interurban roads of northern Ohio and Michigan, and makes possible a continuous trolley trip from Westfield, N. Y., to Port Huron, Mich.

DAYTON, OHIO.—The Inter-State Traction Company, which proposes to build a line from Dayton to Indianapolis by way of Camden and Connorsville, has elected these officers: D. M. Sanger, president; W. H. Heinz, first vice-president; E. R. Beard, second vice-president; C. A. Cline, secretary; A. B. Landis, treasurer, and J. D. Boroff, general manager.

MEADVILLE, PA.—Charles W. Davis, of Linesville, one of the promoters of the proposed electric railway from this town to Geneva, Ohio, states that the contract for the building of the line will be let very soon.

GREENVILLE, PA.—A charter has been granted to the Greenville Street Railway Company, the incorporators being William C. Wilbert, Arthur H. Springer, R. H. Washabaugh, Samuel G. Bailey, J. D. Wild, Machael J. Ryan and M. A. Wilson, all of Pittsburg. The company will build an electric railway in Greenville.

PITTSBURG, PA.—The Jeannette, West Newton & Monongahela Railway Company has elected officers, and has arranged to begin construction before the end of the month. The capital is $4,000,000. All rights of way have been secured and the line will extend across country to the river district of Westmoreland County through a territory with a population of 20,000.

PHILADELPHIA, PA.—By the installation of additional equipment at its power plant at Second Street and Wyoming Avenue, the Philadelphia Rapid Transit Company is now enabled to supply power to all the lines south of Washington Avenue from the sub-station at Broad Street and Snyder Avenue. The difference of potential of transmission from the Wyoming plant is 13,500 volts, and the new installation is part of the company's general plan to high-voltage distribution.

NEALS SHOALS, S. C.—It is stated that W. J. Oliver has signed a contract to build an electric railway from Neals Shoals to Union. Work to begin June 1.

ANDERSON, S. C.—The Carolina Development Company, which is to have charge of the building of the electric railway between Anderson and Greenville, has organized as follows: F. G. Brown, J. A. Brock and R. S. Ligon, of Anderson; H. J. Haynsworth, of Greenville; Capt. E. A. Smyth, of Pelzer; Frank M. Faurier, S. S. Rhoads and Dr. Geo. E. Caughlin, of Indianapolis, and D. M. Stewart, of Xenia, Ohio, directors; Dr. Geo. E. Caughlin, president; R. S. Ligon, vice-president, and J. A. Brock, secretary and treasurer.

TEMPLE, TEX.—The Temple-Belton Traction Company, which is building an interurban electric railway between this place and Belton, has been formally organized with a capital stock of $250,000. Its principal office is at Temple. The incorporators are Calvin Green, W. C. Davies, J. C. Horn, A. C. Mayer, of Lewiston, Pa.; Samuel Watts, of Belleville, Pa.; L. F. Treaster, W. R. Barefoot, of Milsay, Pa.; H. E. Ahrens, of Reading, Pa.; A. M. Brown, of Tyrone, Pa.; A. F. Bentley, of Temple, and N. K. Smith, of Belton.

CHELAN, WASH.—Judge W. J. Long, of the Chelan Water Power Company, is promoting an electric railway from Rock Island through the wheat country around Big Bend and down the Columbia River to Chelan. A. Betts, of Spokane, and J. F. Sullivan, of Couer d'Alene, Idaho, are also interested in the project. The company is to be known as the Big Bend Railway Company.

TERREBONNE, QUE.—The Charlemagne Traction & Power Company is seeking incorporation to construct an electric railway connecting Terrebonne, Montcalm, L'Assomption and Berthier.

ST. THOMAS, ONT.—St. Thomas, which operates municipally the local street railway system, may take advantage of its charter to build an electric railway to Port Stanley. The City Council has referred the question to a special committee for consideration.

OTTAWA, ONT.—At the close of the last fiscal year of the Dominion, there were 759 miles of electric railway in Canada completed and in operation, 185 miles being double tracked. The paid up capital amounted to $57,274,853, of which the municipal aid amounted to $173,000. The gross earnings aggregated $7,233,677, an increase of $747,239, and the working expenses $4,472,858, an increase of $670,000, leaving the net earnings $2,760,819. The number of passengers carried was 155,662,812, an increase of nearly 18,000,000, and the freight carried amounted to 371,286 tons. Power was supplied in fifteen cases by water, and in thirty cases by steam. Ontario has 412 miles of electric railways, Quebec, 242; British Columbia, 49; Manitoba, 20; Nova Scotia, 24, and New Brunswick, 12.

NEW INDUSTRIAL COMPANIES.

THE PATRICK HIRSCH COMPANY, of New York, has been incorporated at Dover, Del., for the purpose of acquiring steam and electric railways. The capital stock is $10,000.

THE THOS. DEADERICK ELECTRIC COMPANY has been incorporated as the Standard Electric Company of Nashville, Tenn., capital $15,000. Thos. Deaderick, W. W. Page and others, of Nashville, are the incorporators.

PERSONAL.

MR. CHARLES MANTNER, formerly manager for the H. Krantz Manufacturing Company, of Brooklyn, N. Y., is now manager of the Switchboard Manufacturing Co., New York.

MR. W. J. CLARK, manager of the foreign department of the General Electric Company, sailed for Europe May 24 on the North German Lloyd liner *Kaiser Wilhelm der Grosse*.

MR. H. W. RILEY, who superintended the construction of laying the electric lighting conduit in Havana on behalf of the contractors J. G. White & Company, New York, is back from Cuba, after completing the work.

MR. P. T. ACKERSON, formerly in charge of the supply sales department of the Western Electric Company at Chicago, has accepted the position as manager of sales for the American Transformer Company, of Newark, N. J.

PROF. ALBERT W. SMITH, head of the departments of mechanical and electrical engineering at Stanford University, Cal., has resigned in order to accept the post of director of Sibley College of Mechanical and Electrical Engineering at Cornell University.

MR. NORBERT B. KATES, of the expert commission house of Kates & Bok, New York, which concern handled considerable quantities of electrical equipment for the South American markets, is about to leave on an extended trip to Mexico with a view to closing some fair-sized orders for electrical equipment, supplies, etc.

MR. ARTHUR STANLEY RIGGS has returned from Manila, where for several years he was engaged in newspaper work, latterly as city editor of the *Cable Times*. The *Atlantic Monthly* several months ago printed an interesting paper from the pen of Mr. Riggs on the Philippine situation, which was widely noted in American papers.

MR. Y. KINOSITA, of Oki & Company, Yokohama and Tokio, contractors in electrical equipment to the Japanese Government, who has been on a hurried visit to this side, has left for home. It is confidently expected that shortly after his arrival in the Far East some very interesting contracts will be placed as a result of his trip here.

MR. CHUJI AWOYAMA, electrical engineer to the Imperial Japanese Department of Communication and to the Imperial Tokio Telephone Exchange, has sailed for home after a brief sojourn in the States. In a report which he will draw up for submission to the Japanese Government he will recommend the purchasing of a big quantity of electrical apparatus on this side.

PROF. CLARENCE FELDMANN, of the Darmstadt Technischen Hochschule, is on a visit of several months to the United States. Prof. Feldmann is well known to engineers as the designer of the Frankfort central stations the prototype of the great central stations of to-day, and from his writings, the most recent of which is a comprehensive treatise on the arc lamp.

MR. CYRUS ROBINSON, first vice-president and general manager of the Power and Mining Machinery Company, formerly the Loomis-Pettibone Gas Machinery Company and successor to the Holthoff Machinery Company, 52 William Street, New York, will leave for Mexico next week in order to attend the starting up of the Velardena Mining & Smelting Company's power plant, reference to which is made elsewhere in this issue.

MR. JAMES W. LYONS, who has been for many years associated with the Allis-Chalmers Co. in the capacity of engine salesman, has been appointed manager of the newly-created power department of the Allis-Chalmers Co., with headquarters in Chicago, the appointment taking effect Monday, May 16, 1904. This newly-created power department will control the sales of reciprocating steam engines, steam turbines (entire units including turbo-generators), condensers, gas engines, pumping engines, blowing engines, hoisting engines, air compressors. Mr. Lyons' promotion will gratify his many business friends throughout the country.

MR. B. G. WASSERMANN, of J. Wassermann Company, which concern is affiliated with the old established German commission house of J. Wassermann & Company, of Hamburg, and has recently opened offices at 35 South William Street, New York, leaves for South America early next month for the purpose of opening a branch establishment in Buenos Ayres, Argentine Republic, where yankee electrical equipment, supplies, etc., will be handled on an extensive scale for that market. Mr. Wassermann will be accompanied by Mr. Otto E. Glocke, formerly manager of the European department of the mercantile firm of G. Amsinck & Company. Mr. Glocke will have charge of the Buenos Ayres offices.

MR. G. MARCONI sailed back last Saturday to England again on the *Campania* to perfect his arrangements to furnish the Cunard Company with a daily news service. He arrived on the same vessel, and, not finding his contemplated trip to the Cape Breton station necessary, sailed on the steamer to put the finishing touches to his scheme. On his return trip he hopes to have everything in working order. The greater part of the voyage will be spent by Marconi in experimenting as to the most favorable situation on the vessel for the receiving and sending of messages. He says the rooms now in use are too small for the latest instruments, and he does not believe that they are in the best place—one amidships on the main deck and the other just aft of the bridge.

NEW INSTITUTE MEMBERS.—At the May meeting of the American Institute of Electrical Engineers, 64 new associate members were elected as follows: Adam, Fred B., secretary and manager, Frank Adam Electric Co., St. Louis, Mo.; Barclay, George, New Zealand Volunteers, Palmerston, Otago, N. Z.; Bates, Francis Reed, consulting engineer, Bogart-Bates Co., Seattle, Wash.; Beckett, Bergie Barry, student, Cornell University, Ithaca, N. Y.; Blizard, John Walter Frederick, chief draughtsman, Keystone Telephone Co., Philadelphia, Pa.; Bramhall, Charles A., manager, Diehl Mfg. Co., New York City; Brosius, James Simms, engineering apprentice, Westinghouse Electric Mfg. Co., Pittsburg, Pa.; Brown, Alfred Evelyn, partner, Scott and Brown, Christchurch, New Zealand; Byllesby, Henry Marison, president, H. M. Byllesby and Co., Chicago, Ill.; Curtis, Leonard E., vice-president and treasurer, Guanajuato Power and Electric Co., Colorado Springs, Colo.; Dean, George Cooper, member of firm Johnston and Dean, New York City; d'Humy, Fernand Emile, district electrician, Postal Telegraph Cable Co., Boston, Mass.; Dunwoody, Henry H. C., instructor, Commanding Signal Corps Post, Fort Myer, Va.; Edwards, Charles Griffin, assistant engineer, Electrical Commission of Baltimore, Md.; Eveleth, Charles Mirick, assistant engineer, American Telephone and Telegraph Co., New York City; Francisco, Ferris Le Roy, supervising electrician, Consolidated Tobacco Co., New York City; Fridenburg, Henry Leslie, secretary and manager, Electric Utilities Co., New York City; Fries, Jons Elias, engineering department, New York Edison Co.; Gale, Frank Harvey, advertising manager, General Electric Co., Schenectady, N. Y.; Gilliland, Clarence Rey, correspondent, Westinghouse Electric and Mfg. Co., Pittsburg, Pa.; Glenn, Charles Sewall, electrical inspector, Baltimore and Ohio R. R., Newark, Ohio; Goehst, J. Henry, construction superintendent, Chicago Edison Co.; Goldsmith, Leon, Westinghouse Electric and Mfg. Co., Columbus, Ohio; Hicks, De Forest, manager, Western Electric Co., Philadelphia, Pa.; Howell, Cecil Ashbrooke, transformer designing engineer, Wagner Electric Mfg. Co., St. Louis, Mo.; Howell, George D., engineer in charge, Lake Erie Traction Co., Philadelphia, Pa.; Hyman, Wallace Munroe, assistant P. R. Moses, New York City; Joseph, Theodore Harold, member of firm E. J. Electric Installation Co., New York City; Kodjbanoff, Basil George, illuminating engineer, Benjamin Electric Mfg. Co., New York City; Lamme, William Fenner, construction department Westinghouse Electric and Mfg. Co., San Francisco, Cal.; Lea, Edward S., sales manager DeLaval Steam Turbine Co., New York City; Lee, William S., Jr., vice-president and chief engineer, Catawba Power Co., Rock Hill, S. C.; Lombard, Percival Hall, salesman General Electric Co., San Francisco, Cal.; Ludwig, Rudolf Emmanuel, electrical engineer, Ludwig and Co., Atlanta, Ga.; Mansfield, Edward Stacey, Edison Electric Illuminating Co., Boston, Mass.; McKay, Maurice Parker, engineer, Westinghouse, Church, Kerr and Co., New York City; Moody, William Edgar, draughtsman, American Elevator Co., Columbus, Ohio; Moore, Clifford Thompson, electrician U. S. Navy Yard, League Island; Mountain, John Theodore, load despatcher, Chicago Edison Co.; Müller, Henry Nikola, electrician, Allegheny County Light Co., Pittsburg, Pa.; Nicholson, Lloyd Carlton, instructor, University of Missouri, Columbia, Mo.; Norton, William John, agent, Federal Electric Co., Baltimore, Md.; Nurian, Kerson, superintendent of construction, Main Switchboard, Mechanical and Electrical Dept., World's Fair, St. Louis, Mo.; Osthoff, Otto Earnest, electrical engineer, H. M. Byllesby and Co. Chicago, Ill.; Pettit, James Edward, chief operator, Postal Telegraph Cable Co., Chicago, Ill.; Pierson, Henry Gregory, member of firm, Foote, Pierson and Co., New York City; Potter, Herbert Sturgis, electrical engineer and contractor, Boston, Mass.; Roberts, George Clifford, electrical engineer, Philadelphia, Pa.; Schneider, Carl Albert, student, Columbia University, New York City; Schuler, L., electrical engineer, Wagner Electric Mfg. Co., St. Louis, Mo.; Schwabacher, Frank, student, Columbia University, New York City; Skog, Gustaf Emanuel, erecting engineer, Westinghouse Electric Mfg. Co., Wilkinsburg, Pa.; Slemin, Harry C., telephone engineer, Stromberg-Carlson Telephone Mfg. Co.. Rochester, N. Y.; Smith, Robert James, superintendent, Canadian Electric and Water Power Co., Ltd., Perth, Ont., Can.; Stimpson, Clarence Arney, chief operator, Postal Telegraph Cable Co., Philadelphia, Pa.; Stratton, Samuel W., director of National Bureau of Standards, Washington, D. C.; Streng, Lewis Starr, assistant engineer, Public Service Corporation of New Jersey, Newark, N. J.; Thomas, Stephen A., chief electrical inspector, Department of Education, New York City; Wallace, John Eugene, assistant engineer, L. B. Stillwell, New York City; Weber, Frederick Carl, tester, General Electric Co., Schenectady, N. Y.; Wiswell, Orzo N., Snoqualmie Falls and White River Power Co., Snoqualmie Falls, Wash.; Wolls, William A., chief engineer Peruna Drug Mfg. Co., Columbus, Ohio; Woodmansee, Fay, electrical engineer, Sargent and Lundy, Chicago, Ill.; Youngblood, Frank James, special apprentice, British Westinghouse Electric and Mfg. Co., Manchester, England.

LEGAL.

BIG COLORADO JUDGMENT.—Judgment for $205,280.65 has been rendered in the district court at Colorado Springs, Col., against the Colorado Electric Company in favor of Eastern bondholders represented by the Union Trust Company, of Pittsburg, Pa. The court has ordered a public sale of the plant at Canon City and all other holdings of the company unless payment is made within five days. The judgment was rendered on a mortgage for $250,000, part of which has been paid. No defense was entered, the case going by default.

TELEPHONE RIGHTS OF WAY.—The law as interpreted by the Pennsylvania courts, defining the rights of telephone and telegraph companies says that a telephone company has no rights on private property except those which are granted by the owners, which is, no doubt, old and good law. As to the highways in the country, they have a restricted right of eminent domain, subject to a reasonable compensation to the abutting property owners, but no compensation can be demanded by abutting property owners in cities where wires are strung on streets with the permission of Councils. In no case has a telephone company the right to make use of house-tops for any purpose without the consent of the owner of the property, and the latter have redress for service and destruction of property where houses have been so used without permission.

MEASURING INSTRUMENT LITIGATION.—Judge Lacombe, of the United States Circuit Court for the Southern District of New York, on May 9, filed an opinion in the case of the Weston Electrical Instrument Company against the Whitney Electrical Instrument Company and Machado & Roller, declining to grant an injunction against the Whitney Company and Machado & Roller upon the Weston patent No. 392,387, which was recently sustained against the Jewell Electrical Instrument Company and the Keystone Electrical Instrument Company. The case was argued at length by Messrs. Kenyon & Kenyon on behalf of the Weston Company and by Mr. C. V. Edwards on behalf of the Whitney Company and submitted upon voluminous papers. Machado & Roller, the general selling agents of the Whitney Electrical Instrument Company, announce that, in addition to this recent emphatic decision another suit brought by the same Weston Company against the Whitney Electrical Instrument Company and themselves on Weston patent No. 446,489, likewise covering Weston instruments, was dismissed upon final hearing by the Court in October last and costs assessed on the Weston Company.

ANNUNCIATOR DROPS.—The U. S. Circuit Court of Appeals of the Sixth District has handed down an opinion sustaining the lower court in its decision declaring that the North Electric Co. had not infringed certain claims in a patent issued to James C. Warner and owned by the Western Electric Co., relating to an electric annunciator drop. The North Electric Co. was represented by Mr. Albert Lynn Lawrence, of Cleveland, and the appellants by Messrs. Rector, Barton and Tanner, of Chicago. One claim of the patent of Warner involved surrounding an annunciator coil with a soft iron shield to minimize induction therefrom as far as possible. The court held that it was not new to surround the magnet coil of an annunciator with a shield or tubing of soft iron, an English patent to Faulkner, issued in 1875, describing this construction. Prof. S. P. Thompson, in his "Elementary Treatise on Electricity in Magnetism," in the edition of 1887, also pointed out the use of a shield to secure the space outside of the coil from magnetic influence. A number of patents were adduced to show that the Warner claim for leading-in device of the wires of the helix through the armature is not new. The court held that if this claim is to be sustained at all, which is a doubtful matter, it can only be sustained by confining Warner to the specific device he has secured, and thus limited the defendant does not infringe. The court affirmed the decree dismissing the bill charging infringement.

Trade Notes.

BULLOCK ELECTRIC MFG. COMPANY announces that its New York offices, of which Mr. E. W. Goldschmidt is the district manager, have been moved to the Empire Building, 71 Broadway.

INCREASE OF SUMTER CAPITAL.—The capital stock of the Sumter Telephone Manufacturing Company, Sumter, S. C., is to be doubled. A new building has been added and new machinery installed, costing nearly $50,000, which has been paid out of the surplus profits.

D. M. STEWART MFG. COMPANY, of Chattanooga, Tenn., finds that Lavite is selling quite largely. It has made recent additions and improvements of its plant which will enable it to fill orders promptly. Lavite insulation is very well known throughout the electrical field.

FUSELESS ROSETTE.—Pass & Seymour, Inc., Solvay, N. Y., report that they are meeting with unqualified success in introducing their new fuseless rosette for concealed work. It is not only easy to install, but makes a finished job, completely concealing wires, tubes, etc. A request addressed to Pass & Seymour, Inc., mentioning their trade number 604, will bring a free sample.

CROCKER-WHEELER COMPANY, Ampere, N. J., has just issued a very tasteful pamphlet entitled "Uncle Sam Printer," giving an illustrated account of its fine installation of generators and hundreds of motors in the Government Printing Office at Washington, D. C. The pamphlet is based upon the series of articles on the subject that appeared in the ELECTRICAL WORLD & ENGINEER at the beginning of the year.

GERMANIA LAMPS.—The Germania Electric Lamp Company, Harrison, N. J., has just issued a very neatly gotten-up price list of its electric lamps. It contains some common sense facts about incandescent lamps, and half-tone illustrations of representative types of Germania lamps. The standard Germania lamps are made in efficiencies of 3.1 watts, 3.6 watts or 4 watts per candle, for voltages of from 75 to 130. The company also makes a complete line of special lamps.

THE INTERNATIONAL TELEPHONE MFG. COMPANY, Chicago, states that it was not affected adversely, either directly or indirectly, by the recent self-restoring drop patent decision. On the other hand it has had a constantly increasing demand for its new "never failing" self-restoring drop for new exchanges as well as for increasing boards of other makes. Its drop and jack can be fitted for any size plug and for mounting on any style of board.

UNDERWRITERS' RULES.—We have received from the Pettingell-Andrews Company, Boston, Mass., a copy of the National Electrical Code for the installation of electric wiring and apparatus, as recommended by the Underwriters' National Electric Association. It is of pocket size, and has a substantial green-leather cover into which it can be slipped and withdrawn. In this form it will be found very serviceable and ready for reference, as it can be easily carried in the pocket.

FLOATING CURRENT MOTOR.—Mr. J. Rauscher, electric push button manufacturer, at St. Paul, Minn., has invented and received a patent for a floating current motor. Mr. Rauscher's factory being located for 12 years on West Third Street, giving him a good view of the Mississippi River, caused him to think of the enormous power being wasted. During his leisure hours he made a few sketches and then a model. The first not being satisfactory he made a second and then a third which he took and tested in the Mississippi River, and which test proved highly satisfactory. He is now building a more highly improved motor, all improvements being covered by patents applied for, which he will give a thorough test on the Mississippi River about July 1. It is claimed that this machine can be built to produce 500-hp.

SPECIAL LIGHTING AT HARTFORD, CONN.—For the encampment and reunion last month at Hartford, Conn., of the Army of the Potomac, some fine special lighting effects were carried out. Nearly 25,000 lights in all were used temporarily on 1½ miles of street, the extra work requiring 15 men 10 days, and then it could not have been done without the aid of the Norbitt sockett. The current was furnished chiefly from the storage battery of the Hartford Electric Light Company. General Electric lamps were used. The construction was superintended by Mr. E. Baldwin, of Rice & Baldwin, local electrical contractors, who carried out all the plans and designs most successfully. All the emblems, stars, etc., were of the new changeable system of the Electric Carriage Call Company, of which Mr. Mortimer Norden is general manager. The local press spoke highly of the whole work.

CURTIS STEAM TURBINE.—The Curtis steam turbine has been very fully described and illustrated in these columns, and our readers are already familiar with this recent type of prime mover and its advantages. It is now classed as a standard product and is the subject of a special trade pamphlet just issued by the General Electric Company. The pamphlet is gotten up in the finished and artistic style which characterizes this company's trade literature. It is printed on fine coated paper, with artistically executed engravings. The machine is very completely and clearly described and the many excellent half-tones and line illustrations show it off to the best advantage. Many illustrations of details are also shown for the first time. The list of illustrations includes turbines of various capacities, ranging from 500-kw to 5000-kw, a particularly interesting feature being those showing the comparative sizes of turbines and steam engines of equivalent capacities. As is well known, the steam engine suffers by comparison. The rapidity with which these turbines have grown in favor forms a unique chapter in the history of industrial development, and engineers will no doubt peruse the pages of this new catalogue with unusual interest and care.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 17, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

759,858. AIR BRAKE MECHANISM; Guss A. Brooks, Covington, Ky. App. filed June 15, 1903. When the car motor is driven by the momentum of the car, it serves as a generator to supply current to an electric motor which actuates an air compressor for the brakes.

759,880. ELECTRIC ARC LAMP; Otto Gross, Manchester, England. App. filed Dec. 11, 1903. Details of a clock-work driving friction wheels which bear directly upon the carbon rod to feed the same.

759,887. PROCESS OF MANUFACTURING PEROXIDS; Friedrich Hinz, Berlin, Germany. App. filed Nov. 23, 1903. (See page 1026.)

759,900. ARMATURE WINDING; Frank A. Merrick, Johnstown, Pa. App. filed Oct. 25, 1900. The end connections of each coil are made with two bends, of offsets, in substantially radial directions, so that each end portion has two parts which lie entirely in different circumferential planes.

759,904. REGULATING APPARATUS FOR THEATRICAL ELECTRIC LIGHTING; Ernst F. Moy and Percy H. Bastie, St. Pancras, London, England. App. filed Dec. 11, 1903. Regulating apparatus enabling the operator to control the dimmers separately or collectively from a distance.

759,909. ELECTRICAL FURNACE; Richard M. Pelton, Detroit, Mich. App. filed Dec. 3, 1902. (See page 1026.)

759,915. ELECTRIC SWITCH; Max Von Recklinghausen, New York, N. Y. App. filed April 22, 1902. Details of a cut-out wherein the circuit is broken by a sudden movement while the contacts are immersed in oil, the device being especially adapted for making a quick rupture of the starting circuit of vapor electric lamps.

759,916. QUICK BREAK OIL SWITCH; Max Von Recklinghausen, New York, N. Y. App. filed April 22, 1902. A modification of the preceding invention.

759,927. COIL CASING; Charles F. Splitdorf, New York, N. Y. App. filed July 24, 1903. Details of a water and dust proof casing for induction coils; also an inclined passage for the wires leading to the binding posts, for shedding rain water.

759,941. PLUG RECEPTACLE FOR ELECTRIC CIRCUITS; John H. Trumbull, Plainville, Conn. App. filed Oct. 9, 1903. Details of a receptacle set flush in the wall and having a cover plate which ordinarily closes the orifice when the lamp is not in position.

759,962. PLURAL LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed Dec. 9, 1901. Details of construction of a cluster socket including the arrangement of the various contacts beneath the finishing cap and their mounting upon the insulating base.

759,963. PLURAL LAMP SOCKET; Reuben B. Benjamin, Chicago, Ill. App. filed July 18, 1902. Further details of a cluster socket having special reference to a series connection of the lamp.

759,967. ALTERNATING CURRENT MOTOR; Alexander J. Churchward, Brooklyn, N. Y. App. filed March 29, 1897. Means for keeping the armature at synchronous speed in a machine of the ordinary direct current type, when supplied by alternating currents.

759,981. ELECTRIC CABLE; Johannes Frisch, Mulheim-on-the-Rhine, Germany. App. filed May 5, 1902. The cable has a core of insulating material of star-shaped cross-section, the conducting wires being wound spirally about the same, the object being to lessen the electro-static capacity.

759,987. FACSIMILE TELEGRAPH APPARATUS; Ernst K. Gruhn, Dresden, Germany. App. filed Nov. 20, 1902. A stylus, a lever connected therewith and mounted to have a bodily as well as an oscillatory movement, a resistance body whose resistance is varied by the oscillatory movements of the lever, whereby the movement of the stylus is decomposed into orthogonal co-ordinates to effect a variation in the resistance of the line conductors.

760,029. TELEGRAPH SOUNDER; John F. Skirrow, East Orange, N. J. App. filed Jan. 8, 1904. A sounder wherein the electro-magnet may be adjusted toward and from the armature without changing the angular relation of the magnet cores and the armature.

760,057. PROCESS OF ELECTRICALLY SMELTING MATERIALS; Alfred H. Cowles, Cleveland, Ohio. App. filed Oct. 20, 1903. The material is placed in a conductive receptacle, the walls of which are kept cool by circulation of water to prevent short-circuiting of the current through them which would otherwise occur by reason of the heated condition of the material in contact with the walls.

760,065. BASE FOR INCANDESCENT LAMPS; Howard Gilmore, Boston, Mass. App. filed Nov. 22, 1901. The porcelain button in the end of the base is held in place by a shell eyeletted in.

760,075. ELECTRIC HEATER; George I. Leonard, Pasadena, Cal. App. filed Oct. 27, 1902. The resistance is a sheet of asbestos coated with a film of rubber over which a layer of graphite is placed.

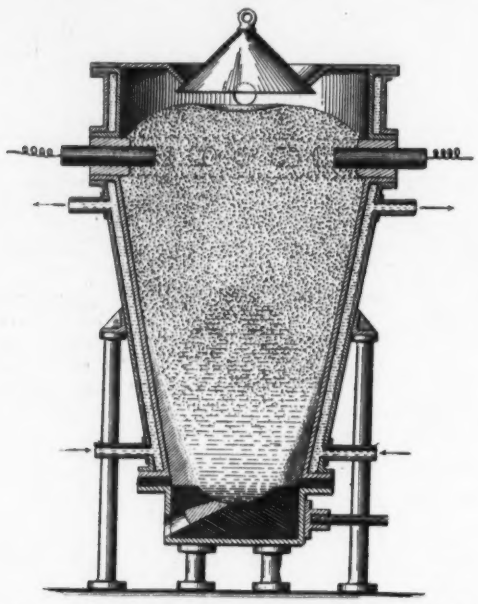
760,076. ELECTRIC HEATER; George I. Leonard, Pasadena, Cal. App. filed Jan. 22, 1903. Various details concerning the mounting of resistance plates in vertical positions above a base.

760,077. ELECTRICAL SWITCHBOARD; Ernest W. Muller, Brooklyn, N. Y. App. filed Nov. 20, 1902. The board has a rearward horizontal extension at the bottom, upon which the fuses are mounted to make it less dangerous to attendants who may be working upon the other devices mounted at the back of the board.

760,079. TROLLEY; Frank A. Overdier, Columbus, Ohio. App. filed June 30, 1903. Two wheels arranged in tandem in a harp mounted upon a vertical axis at the end of the pole.

760,081. AUTOMATIC SWITCH INDICATOR; Dewey S. Rice, Weatherly, Pa. App. filed Dec. 24, 1903. Details.

760,086. DYNAMO ELECTRIC MACHINE OR MOTOR; Imle E. Storey, Amsterdam, N. Y. App. filed Sept. 15, 1903. The field magnet core and pole has a chamber whose opposite walls converge to a point near the pole face, forming a stricture in the magnetic path at that point, to prevent the



760,057.—Process of Electrically Smelting Materials.

lines of force from serging from one-half of the pole into the other by reason of the rotary motion of the armature.

760,091. AUTOMATIC REGULATOR FOR ELECTRIC CIRCUITS; Montgomery Waddell, New York, N. Y. App. filed June 18, 1903. A shunt wound generator, a variable resistance in series with its field magnet winding, electro-magnetic means for controlling the resistance, said means being in series with the working circuit of the generator and also having a coil connected on one side to the working circuit and on the other side to the field magnet winding between the same and the resistance.

760,096. PROTECTING DEVICE FOR VAPOR ELECTRIC APPARATUS; James R. Baker, Arlington, N. J. App. filed Nov. 6, 1903. The pockets for the mercury electrodes contain a cushioning material, preventing the shock which occurs when the mercury forcibly flows into the pocket, from rupturing the lamp.

760,119. MEANS FOR PROTECTING VAPOR ELECTRIC APPARATUS; Peter Cooper Hewitt, New York, N. Y. App. filed Dec. 22, 1903. A modification of the preceding invention.

760,132. CIRCUIT CLOSER; James W. Leech, Staunton, Va. App. filed Oct. 10, 1903. Details.

760,143. APPARATUS FOR AMPLIFYING OR REINFORCING TELEPHONE CURRENTS; Joseph J. O'Connell, Chicago, Ill. App. filed Aug. 22, 1903. (See page 1028.)

760,145. GUARD FOR TROLLEY WHEELS; Charles O. Phillips, Kalamazoo, Mich. App. filed March 2, 1904. Details.

760,159. ELECTRIC BLOCK SIGNAL SYSTEM; Tony Silvene, Victoria, Can. App. filed May 29, 1902. Details.

760,163. TROLLEY CATCHER; Irwin W. Smyth, Dayton, Ohio. App. filed Jan. 25, 1904. A spring drum and pawl and ratchet arrangement for winding up the cord.

760,184. TROLLEY POLE HEAD; Robert I. E. Dunn, Dallas, Tex. App. filed Aug. 29, 1903. Details.

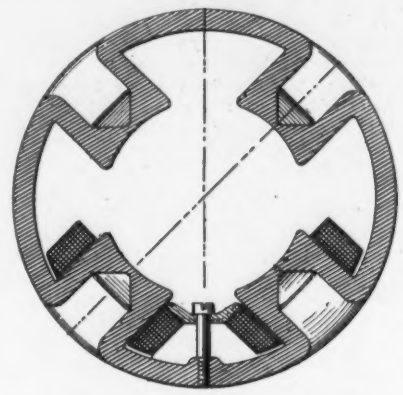
760,209. CIRCUIT CONTROLLER; Paul H. Jaehnig, Newark, N. J. App. filed March 1, 1904. Details of construction of an automatic switch for electric signs.

760,223. ELECTRIC RAILWAY; Thomas D. Lovell, Beverly, Mass. App. filed Jan. 22, 1904. A block system in which the movement of the cars on a single pack road, automatically cuts off the current from adjacent blocks.

760,231. TROLLEY BASE; Peter D. Milloy, Buffalo, N. Y. App. filed Nov. 16, 1903. The object is to produce a low base in which the revolving section surrounds and incloses a greater portion of the fixed section and revolves upon horizontal bearings which are not exposed to the elements.

760,234. ELECTRICAL CAB SIGNAL; Edward McClintock, Merriam Park, Minn. App. filed Sept. 5, 1903. Details of a signal intended to show when the train runs past a danger signal.

760,280. ELECTRIC WATER HEATER; Richard Toennes, Boonville, Mo.



760,086.—Dynamo Electric Machine or Motor.

App. filed Jan. 27, 1904. The water is caused to flow through devious passages, the walls of which form the sides of the circuits.

760,281. ELECTRIC ALARM; Herbert Trull, Fernie, Canada. App. filed Sept. 17, 1903. A fire alarm comprising a tube containing a liquid, the expansion of which moves a plunger to close a circuit.

760,289. ELECTRICAL APPARATUS FOR WORKING RECIPROCATING TOOLS; Alfred D. Williamson and Cecil L. Sumpter, Sheffield, Eng. App. filed Jan. 31, 1903. Apparatus for working planing machines and the like in which provision is made for automatically reversing the direction of the tool and making the return stroke more rapid than the operating stroke.

760,302. PURIFYING APPARATUS; Pierre J. Boucher, Cleveland, Ohio. App. filed March 28, 1903. (See page 1026.)

760,305. COUPLING FOR ELECTRIC WIRES; Ricardo G. Castillo, Mexico, Mex. App. filed Sept. 9, 1903. The coupling comprises a block of insulating material carrying a coupling wire, the conductor wires attached to the block and terminating thereat, are fitted with mercury cups into which the ends of the coupling wire dip to establish a good through connection.

760,312. PROCESS OF MAKING CALCIUM CARBID; Alfred H. Cowles, Cleveland, Ohio. App. filed June 28, 1902. (See page 1026.)

760,315. COMBINED ELECTRIC HEATER AND BATTERY; Jesse R. Davis, Parkersburg, W. Va. App. filed Dec. 8, 1903. Details.

760,325. ELECTRIC RAILWAY; William R. Fearn, Camden, N. J. App. filed Dec. 16, 1903. Details.

760,326. UNIVERSAL FLOOR BOX FOR THE DISTRIBUTION OF ELECTRIC WIRES; John Fountain, Jr., Elizabeth, N. J. App. filed Dec. 16, 1902. The cover of the box is interchangeable and constructed to receive either a supplemental cap flush with the cover, or a nozzle projecting above the cover, both of which have a water-tight connection with the box.

760,330. TROLLEY POLE; James Furgason, Montour Falls, N. Y. App. filed May 28, 1903. Details.

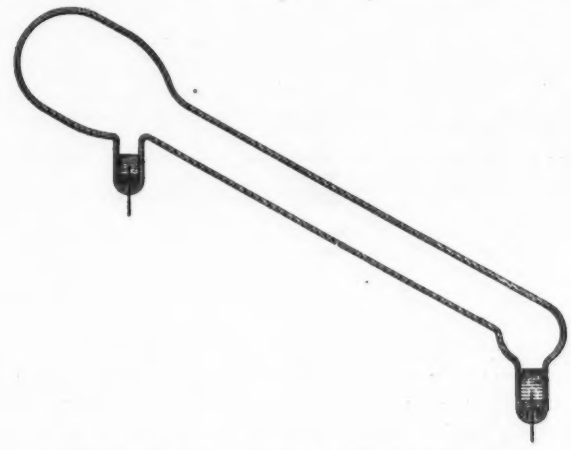
760,361. STEADYING RESISTANCE FOR ARC LAMPS; Louis Wolff, Berlin, Germany. App. filed Dec. 16, 1903. The lamp resistance is coiled around a fireproof layer of insulating material on the outside of the solenoid.

760,375. ELECTRIC LAMP CLUSTER; Reuben B. Benjamin, Chicago, Ill. App. filed March 3, 1902. Details.

760,376. ELECTRIC LAMP CLUSTER; Reuben B. Benjamin, Chicago, Ill. App. filed Nov. 12, 1902. Details.

760,387. ELECTRIC SWITCH; Egbert R. Dull, Chicago, Ill. App. filed Aug. 5, 1901. Details of construction of a switch for operating electric signs.

760,399. SELECTIVE SIGNAL SYSTEM; Fred C. Penfield and Olin Templin, Lawrence, Kan. App. filed March 17, 1902. An improvement upon a pre-



760,119.—Means for Protecting Vapor Electric Apparatus.

vious invention of the same parties, whereby the system is adapted for the common battery method of operating telephone circuits.

760,400. AUTOMATIC OIL SWITCH; Max Von Recklinghausen, New York, N. Y. App. filed Jan. 6, 1904. The invention resides in the construction of a liquid-tight casing for the switch, the latter being operated by a solenoid.

760,408. DYNAMO ELECTRIC MACHINE; Leonard Wilson, Pittsfield, Mass. App. filed June 1, 1903. A construction whereby a wide brush may be used on high speed machines, thus obtaining low current densities and providing ample time for proper reversal and yet wholly avoiding local excess or uneven distribution of current.

Supplement to ELECTRICAL WORLD AND ENGINEER, *May 28, 1904.*

Twenty-Seventh Convention of the National Electric Light Association.

THE twenty-seventh convention of the National Electric Light Association was called to order by President C. L. Edgar at the Hotel Vendome, Boston, Mass., at 10.30 A.M., May 24, some 400 delegates being then in attendance in the hall. Secretary E. H. Davis read a number of letters from prominent men as to absence or intention to be present.

PRESIDENT'S ADDRESS.

President Edgar then delivered an able address which was listened to most intently by one of the largest gatherings that ever witnessed the opening exercises of a convention. He referred to the fact that he had been one of the attendants at the former convention in 1887, as the guest of Capt. Brophy, when he visited the old Thomson-Houston works at Lynn, Mass., when the entire number of men employed was not equal to the number now in any one of a dozen departments. At that time the Boston Edison Company was the possessor of one small station, with a total load connected to its overhead system equal to the fortnightly growth of the present year. Referring to the general growth of the central station business, as represented by the members of the Association distributed throughout the United States and Canada, he found that the number of electric light stations has increased during these seventeen years more than nine fold. Naturally the membership of the Association has not grown in proportion, but the fact that there are now upon the rolls 583 members, as compared with only 158 at that time, is a matter for sincere congratulations. "The work done by my two immediate predecessors in getting new members into the Association stands by itself. The growth this year, as the result of their work, has been rather slow. At the same time, the Association has had a healthy and steady increase in membership and I feel satisfied that it will continue in at least as great a ratio as during the past year."

Mr. Edgar then rehearsed the facts with regard to the Union Engineering Building, New York City, the gift of Mr. Carnegie, and announced that the Association would be able to place its offices there, a plan which he heartily recommended, for its many and obvious advantages. He then took up the question of the constitution and said: "The time has come when it seems desirable to make a somewhat desirable change in the by-laws of your Association. When it was organized some nineteen years ago the industry consisted of a large number of small companies, located throughout the country. Almost without exception, these companies were confined each to its own city; in fact, there were a number of cities, especially those of the larger size, that had a number of competing companies. As time went on, consolidations took place, either by the purchase of a local company by a syndicate or holding company or by the actual amalgamation either of competing or of adjoining companies. This has, at the present time, been carried on to such an extent that in some sections of the country all of the small companies have now been obliterated and one large corporation now covers the territory and does the entire work. A most striking example of this kind comes under my own personal observation. The Boston Edison Company has taken the place of fifteen local lighting companies, all of whom were eligible for membership in our Association. Under the regulations of this State it is necessary to actually wind up these local companies, not only in business, but in a corporate sense, and a number of them have, therefore, had to resign from the Association. Within the next year or two there will be only one company left and the actual membership in the Association will be cut down from seven to one. This is going on all over the country and is a matter of serious concern for the future of the Association. The matter has been discussed at considerable length by the Executive Committee and numerous suggestions have been made for overcoming the difficulty. These have been put in concrete form by your secretary and will be submitted to the Association in executive session. Speaking generally, the remedy suggested is to have another class of membership, consisting of individuals called junior active members, to be elected under some sort of supervision of the active member with whom they are connected in business and paying as dues an amount in keeping with their privileges. I trust that this matter will be given serious consideration by the members of the Association within the next two or three days, so that a conclusion can be arrived at the executive session on Thursday."

Mr. Edgar then discussed a number of important Association topics. The electric lighting industry in this country, he said, has in the past, in certain definite directions, been under somewhat serious disadvantages because of a lack of a comprehensive and correct directory of the industry. In most other lines of work it has been possible for manufacturers, investors or inquirers generally to find out something about the industry in which they were interested. This want was brought especially to his attention sometime during the early part of the year. One of the various circulars issued periodically by the assistant secretary was sent out over the President's name and mailed from Boston. The number of letters returned undelivered was astonishing and the conclusion was arrived at that all the existing lists were worse than useless. About this time a prospect appeared of this work being taken up by one of the members of the Association and put on a par with the publications of other industries of like character. President Edgar thought that members should give their earnest support to this enterprise, incidentally because it is carried on by one of the members, but primarily and selfishly because all members are interested in having it a success.

Referring to the International Electrical Congress, he announced that the Association had accepted an invitation from the Congress inviting it to contribute three papers and to send the authors as delegates to the Congress. The work of the Congress is truly international in its character, papers having been promised by some of the most noted scientists in the world, both in this country and abroad, and for this reason it is extremely desirable that the Association's representation at the Congress shall be in keeping with its standing. Mr. Edgar said that until he became president of the Association, he had no suspicion of the vast amount of work carried on at the permanent office in New York. Under the efficient direction of the assistant secretary, a large and varied correspondence is kept up with the member companies, an average of over ten letters daily being written on all sorts of subjects. In addition to this, various compilations have been made during the year and most of these have been forwarded to the members from time to time. The office is now engaged upon various other reports, notices of which will be given at the proper time. In short, the Association has a thorough and business-like organization, capable of taking up and intelligently discussing almost any subject of interest to the members of the Association.

"Sometime during the winter it was suggested by one of the members of the Executive Committee that there must be a vast amount of valuable information in the records of the Association which were practically useless because of the lack of an index. The matter was taken up at once and there has been prepared a complete index of the papers and reports presented to this Association since its organization, indexed and cross-indexed in various ways. It is intended to publish this as a separate volume for distribution with the proceedings of this convention. I think that none who have not specially looked into this subject realize the great amount of information locked up in the proceedings of the conventions, but which will be available at a moment's notice when this index is published."

Mr. Edgar then noted the resignation of Mr. C. O. Baker, Jr., as master of transportation, commending his long and efficient service; and stated that he had appointed Mr. G. F. Porter in his stead. He then referred to items of the programme and suggested the merging of the "Question Box" and "Wrinkles" departments. He also alluded appropriately to the questions of central station advertising and the sudden and large business that developed last winter in electric thawing—a subject calling, he thought, for special report. He enlarged also upon the duties of the Executive Committee, which

was a body intended to do some work, for even at the best the position of president of the Association was a hard one. "I think that the Executive Committee should be chosen with some reference to their geographical location and with considerable reference to the size of the companies that they represent. Then, in order to make it easy and possible for them to attend the periodical meetings of the committee, an arrangement should be authorized for meeting the necessary expense of these meetings. This matter has been discussed by the Executive Committee during the past year, and I hope they will have some definite suggestions to offer in a report that they will make at the executive session on Thursday.

"Even if this can be accomplished, I realize that the difficulty is fundamental. We must look to our permanent officers to keep the work of the Association going in the right direction. It devolves upon them to instruct the incoming administration as to the precedents and policy of the past and in general to keep the permanent policy of the organization before the mind of each new executive, leaving the latter the privilege of bringing to the office and to the work the strength of his own personality and thus, by a mixture of the old and the new, build up an organization that shall stand distinct and unique among its compeers."

Mr. E. B. Weeks, of Kansas City, one of the earliest presidents of the Association, having been called upon by President Edgar for some remarks, spoke of the enormous growth of the electrical industries, which within the compass of one generation has arrived at the point where the investment runs into billions. He referred to the fact that the great pioneers like Edison, Thomson, Weston, Brush and Sprague, who, with their contemporaries and followers, laid the foundations of electrical industry of to-day, are still actively engaged in enterprises of great moment. The Association is unique in that under it the scientific or technical and the commercial elements have worked together. Contributing to its proceedings have been men like the late Prof. Rowland, men who with little attention to commercial considerations, devoted their lives to study and experimental research; and men of affairs like Mr. Marsden Perry, of Providence, who put hundreds of millions into applied electricity.

PROGRESS.

The report of the Committee on Progress, Mr. T. C. Martin, was a pamphlet of some 36 pages, dealing with a variety of topics of interest to central station managers. The figures and growth of the industry were shown, and the power plants of the lighting and railway systems of the country were contrasted. It was shown that in 1902 the dynamo capacity of the street railways was 1,204,238 hp, and that of the lighting plants was 1,615,480 hp. The output as reported by the companies showed the capacity of the railways to be in use about 8 hours daily and that of the lighting systems 6 hours. Comparisons were also made between the United States and Great Britain, Germany and Spain. The German and English plants average larger than ours. It was shown that 5 watts of new apparatus was installed per head of population in Spain in 1903, in Germany 7.5 watts in 1902; 12 watts per head in England in 1902-3, and 16 watts in the United States of America in 1902. Madrid has 66 watts installed per inhabitant, as compared with 48 watts in Berlin. The profits of the Spanish stations run high, reaching frequently 30 to 35 per cent. Details were then given as to London and Paris, the price per arc in the latter city reaching $240. Figures were cited as to American rates for current.

Mr. Martin then reviewed the progress in the lighting art, and gave a number of details as to the Nernst, Cooper Hewitt, magnetite arc, osmium, Blandel colored arcs, Just incandescent, reflector lamps and other lamps now competing for a foothold. Reference with data was also made to the twenty-fifth anniversary of the Edison incandescent lamp, and some comparisons were then made with gas. A large section of the report was next devoted to electric heating, citing the 20,000 electrically-heated cars in this country; the special plant in the Government Printing Office at Washington, the Berg hat factory in New Jersey and the cooking of waffles in large quantities for the students at Harvard. A final section was devoted to the development of the three-phase central station at Dublin, Ireland, during the present year.

In the discussion of Mr. Martin's paper Mr. E. F. McCabe, of Lewistown, Pa., referred to the fact that the Census statistics showed there is invested in electric lighting companies $504,000,000, giving a gross income of $85,000,000 and a net income of only $17,000,000. Mr. Martin said he had no reason whatever to question the accuracy of these figures, as they were based upon statements of central station men made to the Census Office at Washington. Mr. Samuel Scovill, of Cleveland, Ohio, said that part of the large capitalization should be considered to represent experience—the foresight, courage, ingenuity and inventiveness which have gone to create a great industry. Mr. Arthur Williams, in referring to the Nernst lamp, said he considered its great field to lie just between the largest size of incandescent lamp that can be used conveniently and the smallest size of arc lamp that will give satisfactory results. Here is a gap which the Nernst lamp of three and six glowers fills very satisfactorily and in which at the present time seems to have no entirely satisfactory competitor. The Nernst lamp in combination with the ordinary incandescent lamp, which latter is of a more yellow color, gives very satisfactory lighting results, and he referred to the satisfactory illumination in a club largely used in exhibiting pictures where the lighting was obtained from Nernst lamps at the ceiling and incandescent lamps at the cornices. A year ago it was reported that more than 400,000 Nernst lamps of various sizes were in use in England for interior and outdoor lighting, and very successfully for municipal lighting. He thinks the English experience is that the larger lamp has a greater field.

A THREE-WIRE, 250-500-VOLT LIGHTING SYSTEM.

Mr. Walter I. Barnes, in a paper of the above title, gave an account of the three-wire, 250-500-volt lighting system of the Narragansett Electric Lighting Company, Providence, R. I. The adoption of this system was decided upon in May, 1899, at which time the company had a connected load of about 4,900 kw in alternating current, 2,700 kw in direct-current, 500-volt motors, and 1,400 kw in arc lamps. The previous year an underground conduit system had been commenced and in December, 1901, 40 miles of streets had been opened and 1,700,000 ft. of ducts laid, in which were drawn about 2,000,000 ft. of cable, 1,100,000 ft. of which belonged to the new direct-current system. A storage battery was also installed consisting of 296 cells of 43 plates, the eight-hour discharge rate being 840 amp.

While the conduit system and storage battery were being installed, active preparations were being made whereby existing installations on the alternating-current, two-wire system might be readily transferred to the direct-current, three-wire system. The several sections of the city that were included in the change were served with about 50,000 incandescent lamps, 1,000 arc lamps and 2,000 hp of stationary motors, which installations were reconstructed to comply with the requirements of the new system. The commercial series arc lamps were replaced by multiple enclosed arc lamps, and the series generators thus released from service at the central station. All motors of the direct-current type were connected to the outside of 500-volt wires. When the changes have been finally accomplished the entire incandescent lamp business of the company, amounting to about 185,000 lamps on a 16-cp basis, will be operated at 250 volts and all motors, both direct-current and alternating-current, will be 500-volt machines. The 250-volt incandescent lamps average 3.3 watts per candle-power and have a useful candle-power area of not less than 4,000 hours, assuming the smashing point to be 80 per cent. of the initial candle-power. In 1899 the average watts for this type of lamp varied from 3.8 to 4. The arc lamps at present used are the twin-carbon enclosed type and operated multiple on 250-volt circuits, the current averaging 2.3 amp. and the energy of the lamp about 575 watts.

The discussion of the paper by Mr. Barnes was quite extensive, covering principally the subjects of grounded distribution and the twin arc lamp used on the Providence circuits. Mr. Junkersfeld expressed doubt if a 250-500-volt system has any advantage over the 125-250-volt system. In the incandescent lamp system there is a considerable difference in the energy loss, owing to the use of low-efficiency lamps, and the arc lamp situation is even more serious. The meter losses are double and the meter slip in the course of a year should amount to a very considerable item. While the difference in the investment required may offset these disadvantages, the adoption elsewhere of the system should be a matter to be very carefully considered. Even under circumstances where it might appear particularly adapted the straight alternating-current system would be a serious competitor. Mr. Alex. Dow thought that with the neutral earthed at different points there would, in towns where there is an electric railway system, be a considerable flow of railway current through the neutral circuit of the lighting system. In a case which came under his observation where two earths were on the neutral

three-wire system about 8,000 ft. apart, there was a maintained difference of potential of 10 volts during the evening peak of the electric railway load, this resulting in serious disturbances of regulation and necessitating a special provision for balancing the three-wire system at different points. At times in such cases the current may be so large as to seriously heat the conductors.

Mr. Woodward said that in Providence the lead sheaths of all cables are bonded together in every manhole and there is in every manhole a ground plate bonded to the sheaths and to the copper neutral. In several years' operation no trouble was met with from railway current except in one section of the city very near to a point where the railway cables cross the river. Replying to Mr. Junkersfeld criticisms, he said he understood that by "slip" was meant unaccounted-for meter current, and he failed to see how there would be any more slip with 500-volt meters than with 250-volt meters. When it is considered that a single sub-station with a 250-500-volt, three-wire system would cover 16 times the area that could be supplied from a sub-station operating at 125-250 volts, it would seem a system using the higher voltage would be the better. As to alternating-current competition, he did not see how all classes of motors and all classes of lighting could be supplied with alternating currents at all times, he did not know of a single central station supplying a large area where variable-speed motors are used which has confined itself to alternating-current supply alone. Mr. H. L. Doherty, referring to the matter of meter slip, said that since the torque on the meter is proportional to the amperage and as current is supplied at a higher voltage, the slip would be doubled. As an example of what meter shunt losses may mean, he cited a neutral alternating-current circuit at Madison, Wis., where the shunt meter losses amount to more than the core losses of the transformers. Mr. P. G. Gossler, referring to an account in the paper of the wiring of the Union Trust Building in Providence, the frame of which is used as a neutral conductor, asked what the practice was in buildings not having metallic frames. In reply Mr. Woodward said that in these cases a copper neutral would be run.

In reply to a question from Mr. William Brophy, Mr. Woodward said that the ground of the system consists of a copper conductor neutral; the lead sheathing of the entire cable system and the grounded points at every manhole. In buildings not having iron frames there is a copper neutral, but in such cases the company advocates grounding at all possible points to the water piping of the system in the building. In any event, the copper in the neutral is always sufficient for carrying the current. The grounding of the manholes was an extra precaution which probably was not necessary. Mr. E. V. Matlack, of St. Louis, said that there was a similar system in St. Louis, the voltage, however, being 240-480. The only neutral is the lead sheath of the two-wire cable, while in houses a three-wire circuit is carried as usual. The system has been operated successfully for the last three years without any trouble.

In the discussion of the twin arc lamp it was brought out that the two sets of carbons are in series, the current being 2.5 amp. It was acknowledged that the type of lamp could be improved, but in its present form it gives satisfactory service. The reason for adopting the lamp was that if a customer needed only one arc lamp and the ordinary type were installed, he would have to pay for the current consumed in a rheostat of some similar device. The energy in the lamp is 575 watts, which is the same as would be used in one arc; in one case there is lesser current with two arcs in series, whereas in the other case there would be greater current and lesser voltage.

THE LUMINOUS OR FLAMING ARC.

Mr. Welles A. Holmes read a paper describing the magnetite arc lamp, concerning which an article appeared in these columns last week from the pen of Dr. C. P. Steinmetz. From the paper it would appear that the 320-watt magnetite arc lamp gives slightly more light than a 340-watt open arc or a 460-watt, series direct enclosed or alternating enclosed arc. It is claimed that the main advantage of the lamp is the uniformity of light distribution from it. In the case of the 460-watt lamps the average readable distance from the lamp is 267 ft., while with the 320-watt magnetite lamp this distance becomes 325 ft. The magnetite sticks cost about five cents apiece, and there is no expense for inner globes or washing the same, while the outer globe is of the standard type. It is stated to be necessary to have a perforated globe pan as the lamp is dependent on some slight draft to carry the products of combustion up the chimney; stopping this draft would result in coating the globe with the red oxide given off by the magnetite stick. The life of ½-in. sticks in the lamps used by Mr. Barnes in his station at Watertown, Mass., varies from 63 to 95 hours, and the ⅝-in. sticks have an average life of 182 hours with a maximum of 211 hours. With ½-in. sticks an average life of 100 hours has been obtained.

In reply to an inquiry concerning the coating of globes with red oxide, Mr. Holmes said that at first the holes of the globe were on the side and when the wind blew the oxide was caused to collect on the globe. Experience has shown that the lamp needs a direct upward draft; with the lamp now used the globe opening is indented and has holes drilled in the indented portion so that a side wind cannot get into the globe pan, but must come up from the bottom; this has remedied the difficulty and there is no further coating of the globe with red oxide. The quality of the light depends upon the composition of the magnetite stick and may be varied over a considerable range. In reply to a question he said that the burning of the lamps is in no way affected on windy nights. There is no consumption of the upper electrode, the magnetite stick alone being consumed. The public is very well pleased with the character of the light, and recently after a visit to a town by the mayor and council of another city, the lamp was specified for use in that city. Mr. John F. Hillman referred to the superior street illumination given by the magnetite lamp. With the best 6.6-amp. series direct-current enclosed arcs or the best 7.5-amp. series enclosed arcs, the distance at which a certain line on a luminometer card could be read was 257 ft., while with the magnetite lamp the distance becomes 300 ft. Referring to the amperage of the lamp, it was said that the determination of this was quite a problem. If 6.6 amp. had been used at 80 volts, the same as in the enclosed arc system now operated, there would have been a tremendous amount of illumination, almost like that from a miniature searchlight, except that the light would have been radiated from all four sides. It was finally concluded to adopt an amperage giving the standard illumination as it is to-day; and after getting a little bit better illumination at a distance due to the high efficiency of the lamp and its ability to throw the light horizontally, it was determined to use 300 watts and give the central station the benefit of the difference.

STANDARD RATING OF INCANDESCENT LAMPS.

Dr. Bell, in reporting for the Committee on the Standard Rating of Incandescent Lamps, said that at present primary standard lamps can be procured from more than one concern and in general the conditions relating to standardization of lamps have become such that it is hardly necessary to make an extended report. He feels that the work of the committee was pretty much accomplished when the time came when standard lamps could be easily obtained and a general understanding was arrived at as to what would be desirable in the rating and measuring of lamps, and consequently asked that the committee be discharged. He recommended that in the case of reports of technical character there should be closer co-operation between members of the Association. A proper method of doing work of this kind would be to send to all members of the Association a circular asking for detailed statements of conditions as they find them, and the answers should then be digested and printed as a confidential document, so that every member of the Association would know what the other members were doing. At a following convention a special or general committee could report on the data thus obtained and every one who had participated in gathering material for it could then discuss the situation to the best advantage.

A ONE-HUNDRED-MILE TRANSMISSION LINE.

Mr. Robert Howes described the transmission plant of the Washington Power Company, of Spokane, Wash. The transmission line is 98 miles long to the farthest sub-station, and has three short branches at present. It is supplied with power from two Y-connected, 2,500-kw, 4,000-volt, 60-cycle generators driven by water turbines, the current being stepped up by transformers with taps giving a choice of 60,000 or 45,000 volts line pressure. In crossing a swamp the poles were set on a cluster of five poles, the center one being driven 6 ft. lower than the other and thus furnishing a socket, in which the line pole was firmly clamped with heavy iron bands. No. 2 B. & S. medium hard-drawn copper wire is used. At present unity power factor is usually reached with a load of 1,500 kw, the current in the line being then about 18.5 amp. The line has been in operation for over seven months, during which time the circuit-breaker has been tripped eight times. In two cases this was caused by accidental short-circuits on the line made by the company's workmen; in four cases the cause was short-circuits on the secondaries of customers, and the other two cases were from unknown causes. The total time power was cut off by these troubles 32 minutes.

After reading his paper, Mr. Howes stated that since it was written they have succeeded in holding the voltage at Spokane practically steady, there being a variation not to exceed ¾ volt above or below normal on a 116-volt basis, and at the far end of the line the variation was cut down to a trifle over one-half. This was accomplished by means of the installation of a voltage regulator. A controller was then installed on the induction motor at the far end of the line, which cut down the variation another half. In reply to an inquiry he said that power had never been cut off except to cut in sub-stations, at which times advantage was taken of the opportunity to renew insulators which had been broken by boys throwing stones and shooting rifles at them, making targets of them at rifle practice. In reply to another inquiry he said that they have had a number of severe lightning storms, which are much more frequent in that locality than in the Eastern and Middle States, but they had never experienced any trouble from lightning. During one storm, however, the insulation of a transformer for operating high-tension circuit-breakers in the sub-stations was punctured, which caused a shut-down of ten minutes. This was just before another shut-down of nearly an hour caused by a road supervisor putting several pounds of dynamite under a stump of a tree and projecting it through the wires. Dr. Bell called attention to the fact that people apparently expect of induction motors a greater degree of immunity from troubles produced on the line, and with others that motors are heir to than in the case of direct-current motors. Large induction motors should have the starting rheostats very carefully designed and this is usually not done, the lower steps of the starting rheostats in three cases out of four not being made for the fine gradations that are necessary. With proper attention to the starter relatively little trouble will be encountered with large induction motors. He believes it advisable to run a little under unity power factor all the time, never giving the current a chance to become leading and thereby introducing oscillatory factors, with magnetizing and demagnetizing action on the generator acting in quicker succession in response to changes in load. Mr. W. L. Abbott related some experiences with a 9,000-volt line in Chicago nine miles long with which they frequently have trouble. It was put out of operation once by lightning, twice by boys with hay bailing wire, in one case by a trace chain thrown over the line and again by some one who needed the copper.

GROUNDING THE NEUTRAL OF HIGH-TENSION, HIGH-POTENTIAL ALTERNATORS.

A paper by Mr. George N. Eastman on the above subject (to which we refer editorially in this issue) has for its object to show that any advantage which may be obtained by operating an alternating current insulated from earth, will be more than offset by the liability of obtaining high potentials relative to the earth. The study of the conditions was made on the plant of the Commonwealth Electric Company, of Chicago, and the paper is illustrated with diagrams showing the relations of the several voltages existing in connection with grounded and ungrounded circuits. Mr. Eastman considers that a proper method of grounding the neutral of generators is through as low a ground resistance as can possibly be obtained, in this manner fixing the maximum potential which can be obtained between a system and ground at the normal potential which will exist between the neutral of the generator and its phase terminals. The systems of the Chicago Edison Company and the Commonwealth Electric Company of the same city have been operated with a ground for a period of four years, during which they have apparently been entirely free from the high-potential breakdowns that have occurred on other systems of a similar character operated free from ground.

Mr. Hallberg said that the Cincinnati Gas & Electric Company had operated a system during the past four years similar to that referred to in the paper and with unquestioned success from the practical point of view. He considers it to be by far the most simple and reliable system, and the regulation seems to be everything that could be hoped for. In Cincinnati there has been practically no trouble from lightning, the neutral, if anything, protecting the system from lightning discharges. He recommended, however, that since the neutral is grounded all secondaries should also be grounded.

REMOTE CONTROL OF ELECTRIC APPARATUS.

With the above title Mr. William H. Cole presented a paper describing a system of controlling constant-current transformers connected to circuits of arc and incandescent lamps arranged in single or multiple circuits. As illustrated, the apparatus is shown applied to a constant-current or "tub" transformer. The principle of the device lays in the use of a float connected with the apparatus to be controlled, the float being enclosed in a cylinder to which oil may at will be admitted or withdrawn. The amount of oil, and consequently the position of the float in the tank, is automatically varied in such a manner as to maintain the current constant; the variation in level being produced either by running more oil into the tank or pumping some out of it. In the first case the valve of a supply tank is operated by an electromagnet, and in the second place a small electric motor is started up by means of an electromagnet.

THE ORGANIZATION AND EQUIPMENT OF AN ARC LAMP DEPARTMENT.

Mr. Samuel G. Rhodes described in detail the organization and equipment of a separate department exclusively for the care and maintenance of arc lighting service, in this connection drawing upon experience with the arc lamp department of the New York Edison Company. The paper contains reproductions of seven printed cards and slips used in the system, and gives illustrations of a carbon cutter and punch for cutting washers, an inner globe washing machine, a "Bishop's crook" lamp post and a supply wagon. The method of keeping track of every detail connected with an arc lamp system is described, and the duties of the various classes of employees are detailed. In turning on and off direct-current multiple lamps boys, preferably over 14 years of age and almost exclusively school boys, are employed, receiving $2.50 weekly for 45 minutes actual switching work both night and morning. Three men in charge of the boys cover the entire city of New York.

In the discussion of the paper by Mr. Rhodes it was brought out that during the past several years the arc lighting business appears to have come to a halt. Mr. Gilchrist, of Chicago, said that recently he had noticed a tendency on the part of the general public to use arc lights again, but he thinks this is due to a more strenuous effort on the part of central station people on account of sharp competition from various types of multiple gas burners on the market, and which are a strong competitor to the arc light. Mr. Rhodes said that the advance made in New York has really been the work of the contract department. The lighting engineer is a new departure; when trimmers report that any customer's lamps are acting badly the lighting engineer or one of his assistants is around the next day to remedy any defect. Many people have changed over from the Kitson and Humphrey gas burners, the operation of both of which, especially in the winter time, is very bad. He considers the 3.25-amp. lamp very useful, for if the customer does not want to pay for a 5-amp. lamp he will probably be willing to take a lamp of the lower consumption. Mr. Douglass Burnett, of Baltimore, said that there is little difficulty in getting arc light business now when the solicitation is properly done. The customer should be assisted in locating lamps and sometimes given sketches with a general outline of a scheme for his lighting. For example, he may be advised that for the interior of his store he requires a 5-amp. lamp for every 300 sq. ft. of floor space, the lamp to be located with the arc about 12 ft. above the floor level. For the windows incandescents should be recommended. Arc lamps in the interior of a store will show goods better than anything else to customers, and he cannot produce a brilliant effect in front of the store with interior incandescent lights. In fact, the prospective customer should be advised on every point calculated to make his lighting most effective. He considers that the problem still remains as to how to develop the series arc lamp service.

Mr. Rhodes said that while in the case of large contracts the New York Edison Company does not care for the lamps, yet they keep their eye on the installation and freely offer their service whenever it appears to be called upon. As to maintenance of arc lamps, one trimmer at $14 a week, seven days, will take care of 650 lamps; in the repair shop one man will take care of 2,000 enclosed lamps. In this shop one man at $3.50 a day and the rest at $2 will do the work. Mr. Burnett said that in Baltimore he also used night linemen in the various districts, who were available in case of either an open or grounded circuit and for switching on electric signs and for switching them off again. In reply to a question it was stated that the New York Edison Company and the Omaha Electric Light Company furnish diffusers free to their customers, and Mr. Fleming stated that the General Electric Company will adapt its diffusers to any type of lamp.

LOST AND UNACCOUNTED-FOR CURRENT.

Mr. C. W. Humphrey gave an account of the method used by the Denver Gas & Electric Light Company for determining the losses, known and unknown, from alternating and direct-current circuits. The losses are classified as transformer iron losses, primary resist-

ance losses, secondary resistance losses and meter shunt losses. The methods employed by the Denver Company for determining these losses are given in detail, the paper containing reproductions of forms and curves employed in this work. It was found that the greater part of lost and unaccounted-for current was due to thefts. The paper cites an instance where, through proper attention to reducing losses, the ratio of sales to output increased from 59.3 per cent. to 80.5 per cent. In another case, where a feeder was changed from a 1,000-volt individual transformer to a 2,000-volt, three-wire secondary network, there was a reduction in transformer iron losses of over 60 per cent. In this instance the sales were increased to nearly the original amount and the transformer iron loss reduced to about one-half the original amount, though the primary and secondary resistance losses were increased considerably through the increase of the output of the feeder. In the case of a principal business feeder the watts per lamp of output remained about the same for the entire year, while the watts per lamp of sales increased during the same period to nearly double. The sales increased from 41.6 per cent. to 83.5 per cent., the known losses remained about the same, while the unknown losses decreased from 48.4 per cent. of output to only 5.22 per cent. A check meter placed in a district having nine ampere-hour meters and eleven integrating wattmeters showed a loss in the district of 8.1 per cent., not including about 2 per cent. wattmeter shunt losses. The larger loss was principally due to the ampere-hour meters, which do not start on less than two to four 16 cp lamps.

In reply to a question, Mr. Humphrey said that the total accounted for losses of the Denver station were 10.8 per cent. of the output. In the month of December the sales of output were 85.3 per cent.; the current loss and unaccounted for was 5.2 per cent. and the loss accounted for, 10.5 per cent.

ECONOMY IN MINOR STATION SUPPLIES.

In his paper with this title, Mr. Edgar B. Greene confined himself to a consideration of stations of minor size. In his station there is a course of training which starts a young man as an apprentice either in the steam or electrical side of the plant, and gives him a thorough training in all branches of the work. There is no definite period for this course, the apprentice being promoted as fast as his ability will warrant, there being a distinct understanding that each person must earn his promotion or stand aside for the next man. A number of the apprentices take a course in correspondence schools and this method of education is strongly endorsed. The paper refers to a number of minor economies such as standardizing pipe nipples and valves, using tubing in steam hose for use in cleaning boiler tubes, and a home-made arrangement for bending tubes is described. A lathe has been installed for making simple repairs. The ashes and cinders are carted away free by a railroad company and others having use for them. Arc machine brushes are made from strips of hard-rolled copper .01 in. in thickness; four of these are soldered and a phosphor-bronze strip .02 in. thick is used as a stiffener. All oil from the engines is drained by gravity direct to the oil house, where it is filtered by a home-made apparatus. Defective coils of arc lamps and Thomson recording wattmeters are rewound in the station, as well as all transformers. In reading the meters the routes of the men are changed monthly, and different men instead of the same man are used for this service. After the inner globes of enclosed arc lamps are washed they are tested on a ground steel plate for the closeness of joint and then fitted to the holders, the lower holder being trimmed in the station. At least three days' supply of inner globes are always in course of cleaning or washing, which keeps two days' supply ready for use. With a new man the average life of the inner globe is about 800 lamp-hours for the first month and afterwards from 1,400 to 1,500 hours; the number of lamp-hours per carbon is found about 10 per cent. shorter with a new man on the first month.

In the discussion of Mr. Greene's paper, Mr. N. L. Abbott, of Chicago, said that he knows of nothing which will introduce discord in the operating force so promptly and so continuously as placing an outsider in one of the higher positions over the heads of men who have worked faithfully for years. He has known of cases where discord thus produced has been so great that it was necessary to discharge the entire original force. Concerning oil filtering, he considered there were two functions to be performed, one to remove the grit and the other to remove grease and water from the oil. By removing the water and grease in the settling chamber, he has found there is no need of a filtering material in the oil filter. In reply to a question Mr. Greene said the tubing referred to as prolonging the life of steam hose is the Greenfield flexible tubing made by the Sprague Company, a size being used which will fit neatly in the hose. Mr. M. A. Maxwell, of Easton, Pa., said that he found the life of inner globes to be from 5,000 to 6,000 lamp-hours, and 50 per cent. of the globes replaced are broken by boys. Mr. Greene said that standard Edison fuses are carried by his company in stock for free renewals.

THE GAS ENGINE FOR CENTRAL STATION SERVICE.

Mr. E. E. Arnold contributed a lengthy paper entitled "Notes on the Internal Combustion Engine as Applied to Central Station Service," in which, after briefly outlining the theory of the gas engine, he gives data as to test performances and describes and illustrates a number of central stations equipped with the Westinghouse gas engine. A table gives the results of tests for a large number of gas engines of this type. The best result was on a machine in a Madison (Wis.) central station, which showed a consumption of 9.6 cu. ft. of gas per hp-hour, the gas having a calorific value of 1,050 B.T.U. It is stated that the average efficiency of a producer gas plant may be taken at 80 as a conservative figure. A test is cited of a 75-kw gas engine operating from a Mond producer plant, which during two years' continuous operation showed a consumption equivalent to 1.05 pounds of cheap slack coal per indicated hp-hour. A table is given showing that a 2,000-kw gas engine plant can be run for $3,724 a year less than a steam plant, the higher cost of the gas engine equipment being taken into consideration. In the Bradford (Pa.) central station a gas engine reduced the fuel cost from $9,000 to $3,000 per year. At Madison, Wis., a gas engine plant delivered a kilowatt-hour at the switchboard at a cost of fuel more than ⅓ less than that required for running a steam plant.

TEST OF A 5,500-HP COMPOUND ENGINE AND GENERATOR.

Messrs. J. B. Andrew and W. F. Wells gave the data of a test of one of eleven three-cylinder, 5,500-hp vertical compound engine units installed in the Waterside station of the New York Edison Company. The method of test is described in detail and much of the data are plotted in the form of curves. The test showed that for outputs of from 2,500 to 4,500 kw the steam consumption varied between 17.12 and 18 pounds per kw-hour of net output at the generator terminals. The ratio of the net electrical horse-power to the indicated horse-power varied from 94.5 to 95.2. The best test showed an economy of 11.93 pounds of water per indicated hp-hour or 16.78 pounds per kw-hour. The tests indicated a decided disadvantage in the use of a receiver reheater and steam jacket in this type of engine. The curves show an almost absolute uniformity of economy for a considerable range on either side of the normal rating. Increasing the vacuum from 25.3 to 27.3 in. decreased the water consumption only .06 pound, whereas increasing the receiving pressure from 21 pounds to 36.8 pounds, or changing the distribution of load from about ⅗ on the high-pressure cylinder and ⅖ on the low-pressure cylinder, to about equal load on all three cylinders, decreased the water consumption .25 pound.

THE STEAM TURBINE.

Mr. Francis Hodgkinson contributed a paper entitled "Practical Notes on Steam Turbines," in which, after discussing the principles of this type of prime-mover, brief descriptions are given of the De Laval, Stumpf, Curtis, Zoelly and Rateau turbines, the remainder of the paper being devoted to the Westinghouse-Parsons type. This type is described in detail and a number of curves are given of economy tests. A considerable portion of the paper is devoted to foundations and power plant designs for Westinghouse-Parsons turbine electrical equipments. It is stated that at present 43 turbines of the Westinghouse-Parsons type are in operation or under erection in this country, ranging in size from 400 to 2,000 kw, and aggregating 27,000-kw capacity. There are also 69,400 kw in turbines under construction at East Pittsburg in all sizes up to 500 kw. Including machines in the course of construction, the total is 111 machines, aggregating 96,400 kw, or an average of 868 kw per unit.

The papers by Messrs. Andrew, Arnold and Hodgkinson, and the report of the Committee of Investigation of Steam Turbines by Mr. Eglin, were discussed together. In opening the discussion, Mr. Ralph D. Mershon said he noted that in the plant on which Mr. Arnold gave figures, nothing was allowed for relay capacity, and if this were done it would mean a greater investment to the disadvantage of the gas engine. He has found that most gas engine builders rate their engines at or near the maximum load they will

carry, whereas the steam engine is rated so as to have a considerable overload capacity. He considers that the gas engine should be figured as having a less efficiency at lighter loads, as compared with the steam engine. Referring to the figures given by Mr. Arnold as to cost per kilowatt of steam and gas installations, namely, $100 and $125, respectively, he thought that the figure for the gas engine should not be under $150 and nearer $175. Mr. Doherty said that the serious drawback in gas engine development is in securing economical and satisfactory transformation of the heat energy of coal into gaseous energy. Mr. H. G. H. Tarr spoke of the reduction of cost to be obtained in the generation of gas through utilizing the by-products. In one process, if the coal is worth $2.50 per ton, the by-products reduce the cost to the equivalent of $1.50 per ton, these figures being applicable to larger plants of, say, 50-tons capacity in 24 hours and above. A producer using bituminous coal will cost from $17 to $20 per hp. Mr. W. R. Gardner suggested that peat might possibly be used to make a producer gas at low cost. Mr. R. H. Rice, of Lynn, Mass., in answer to a request, gave a description in detail of the Curtis turbine. Up to and including 300 kw this turbine is constructed on the horizontal type and on the vertical type for capacities above. He stated that tests under actual working conditions have shown that the turbine maintains its efficiency with variable loads. Moreover, the turbine retains its original economy as long as it is operated, while the steam engine is stated to rapidly lose in efficiency due to the wear of its reciprocating parts. All large Curtis turbines are made now with four stages. He cited a case where only two reciprocating engines of 500-kw capacity could have been installed in a certain power house, where five turbines of the same size were readily located. Mr. H. L. Doherty spoke highly of the prospects of the gas engine, and said that to-day practically every authority on thermodynamics believes the ultimate prime-mover will be the internal combustion engine. In his opinion the steam turbine will be left behind by the internal combustion engine, which will unquestionably be the eventual prime-mover. To get the best efficiency in the gas engine it should be operated at its maximum capacity, since the losses are 25 per cent. of the capacity, no matter what the load. Gas engines cost more per horse-power at the start and the fixed charges are consequently heavier. It is, therefore, desirable to operate the gas engine the longest possible number of hours, and an ideal arrangement would be to use a gas engine to take care of that portion of the load which is on 24 hours a day, the variable load being taken up by steam engines. He endorsed a statement by Mr. Arthur Williams that the present gas engine is relatively no better developed now than the steam engine was during the life of Watt, and he believed the gas engine has wonderful possibilities ahead. He thought that the question of the gas producer is not receiving in this country the attention which it deserves and which is being given to it in Europe. As to the smaller space occupied by the steam engine, in his work he had found that he could not always avail himself of the lesser space indicated by the turbine without the use of a system of steam piping that would not be good engineering practice. Several methods have been proposed to reduce the space occupied by boilers. One is to have the boilers installed back to back, giving a double boiler room with the firing door on the side, the steam piping being led from one firing alley to the engine room. Another plan is to build the boilers with the firing doors at right angles to the turbine and have short alleys running up to the groups of boilers. Another way is to design a special boiler having little width and considerable depth, this probably involving a vertical boiler. Another method suggested but not looked upon with favor was to put the boiler room on each side of the turbines. As to condensers, Mr. Doherty says he has never been able to satisfy himself that he cannot get a higher vacuum from a jet condenser than a surface condenser, and he hopes next year to have some definite figures on this subject. The question of superheaters is a rather serious one for it is difficult to control the degree of superheat and the tubes burn out.

Mr. Arnold, in referring to Mr. Mershon's remarks concerning the rating of gas engines, said that these are ordinarily rated at a brake horse-power of 15 to 20 per cent. under maximum capacity. Steam engines are rated on their indicated horse-power with, say, 50 per cent. overload, but the difference between indicated and brake horse-power amounts to considerable, and the actual capacities of the two types of engines approach more closely than would ordinarily be supposed. As a lighting station has ordinarily a 20 per cent. load factor, the relay capacity is well taken care of in the way the units are laid out in the case Mr. Mershon criticises. Smaller gas engine units of approximately the same efficiency as large gas engine units, and the smaller gas engines, are notably more efficient throughout their range of load than the steam engine. As to the relative efficiency of the gas engine at light loads, he referred to a curve in his paper showing that at half load the brake thermal efficiency of the engine was 21 per cent., while that of a steam engine of the same capacity would only have a corresponding efficiency of 10 per cent. As to the depreciation and life of a gas engine in comparison to the steam engine, experience points out that the former quite holds its own with respect to depreciation, though it will perhaps be found that it costs slightly more for horse-power repairs than the steam engine equipment, excluding the more intricate designs of multiple-cylinder, releasing-gear steam engines using superheated steam. He cited a lighting station having a 24-hour service equipped with 800 hp rated capacity in gas engines in five units, complete repairs for which in the year 1903, including repairs to igniters, cost only $102, or something less than 13 cents per hp per year. In reply to an inquiry he said that all plants referred to in his paper are connected with alternating-current generators operating in parallel, and many of the plants are giving 24-hour service. He referred to a 3,000-hp gas engine cement plant which operates 24 hours a day and has been in service about four years. In reply to a question, Mr. L. R. Alberger said that if hot well water is kept away from the atmosphere it is liable to keep its temperature better, while it has been shown that in this case there is less likelihood of corrosion taking place in boilers.

THE MECHANICAL STOKER.

Mr. Edwin Yawger read a paper entitled "The Mechanical Stoker and the Human Operator," in which he pointed out the various factors which should be considered with respect to the introduction and use of the mechanical stoker. He considered that no builder of stokers should put in his apparatus unless he has submitted to him a complete furnace design to enable him to adapt the stoker to the particular case. The paper is principally devoted to practical considerations relating to the operation of boiler plants.

Mr. C. H. Parker said that the higher the temperature of a furnace fire, the better the furnace efficiency. Flue gases analyzed with low fire temperature show a large excess of oxygen. When the grate combustion is run up to 40 or 50 pounds per sq. ft. rate, the excess air kept is brought down something like 30 to 40 per cent., and the fire is a dead white. Better economy may be obtained by reducing a grate area and using a greater number of pounds per square foot, and also per square foot of heating surface. Mr. R. S. Hale, of Boston, said that after analyzing a great many boiler tests he had reached the conclusion that, other things being equal, the less draft used the higher will be the efficiency. If it is a question of getting a greater capacity, then of course a greater draft must be supplied. or if a grate surface is cut down more draft must again be supplied. He disputed the statement of Mr. Yawger that the same volume of gas at the same temperature will give up more of its heat when passed rapidly over a heating surface than when passed slowly. On the contrary, better efficiency is secured by passing the gases more slowly over the heating surface. One reason why the best efficiencies are gained with a low draft is that this implies more careful firing in order to keep up the capacity, and hence reduces the amount of air used, thereby reducing the loss of heat in the waste gases; and since the gas is passed more slowly over the heating surfaces, they give up more of their heat.

AWARD OF DOHERTY MEDAL.

Dr. Schuyler S. Wheeler, chairman of the committee on the award of the Doherty Gold Medal, said that of the various papers submitted on the subject of underground construction, there were two excellent ones, one by Mr. W. P. Hancock, of Boston, and another by Mr. Blood, of the same city. While the paper by Mr. Blood was very good and exceedingly well composed, it was unanimously decided to recommend the award of the prize to Mr. Hancock. The president, in awarding the medal to Mr. Hancock, said that his career had been passed with the Boston Edison Company, of which he is now general operating superintendent, and the designer of the two stations to be visited in the afternoon by the members. In accepting the award Mr. Hancock said he wished there was a greater engineering interest in underground construction. The subject is an extremely important one and should be given close attention. The distribution system should be entirely reliable or the reputation of the company will suffer, and the construction should be such as to keep the operating and repair charges as low as possible in the future.

CENTRAL STATION AUXILIARY ICE PLANTS.

Mr. C. L. Wakefield presented a short paper entitled "Electric Light and Power Plants in Connection with Ice Plants," in which he gave the result of correspondence with about 50 plants supposed to have an ice plant auxiliary. The results showed that very few of the plants were actually so equipped, and with three exceptions, where there are equipments they have been installed without any particular purpose. In his station a 300-kw alternating-current plant operates a 100-ton ice-making plant with the addition of one oiler and one fireman to the regular force. The fuel cost per ton of ice varies from 350 to 700 pounds of coal, depending upon the calorific value of the fuel and the manner of its use.

Mr. Scheuck thought that it was a bad plan for electric light companies to operate ice plants or enter into other classes of industry, excepting steam heating, for the reason that it was likely to antagonize municipally influential persons who might be interested in competitive ventures.

DECORATIVE AND SIGN LIGHTING.

The report of Mr. Arthur Williams on this subject is presented in sumptuous printed form and consists principally of views of New York City buildings and interiors, and reproductions of letters printed on toned backgrounds. The illustrations are mostly views of facade lighting of theatres and other buildings, with some views of interior lighting, the most striking being a representation of the Waldorf ballroom on the occasion of the Edison A. I. E. E. dinner. The letters are principally reports from electrical companies on the subject of decorative and sign lighting. The mechanical execution of the brochure does much credit to the press of the New York Edison Company.

ADVERTISING METHODS.

The report of Mr. La Rue Vredenburgh on this subject is bound in an illuminated cover and relates principally to the methods of advertising that have been employed by the Boston Edison Company. Reproductions are given of a large number of newspaper advertisements and of electrical signs soliciting central station business, and the text points out methods pursued by several of the larger companies in soliciting business.

The reports of Messrs. Williams and Vredenburgh papers were discussed jointly. Mr. Scheuck said that methods which might pay in large plants could not be afforded by companies in smaller cities. Mr. Williams and Mr. Vredenburgh's methods were undoubtedly of great efficacy for the large companies, but there were only a few companies in the United States which could afford them. He was connected with several plants in smaller cities, these plants doing both railway and lighting business. He had found one of the best methods of getting new business was to print small booklets and to supply them to metal holders in the street cars each day. In a town of 50,000 inhabitants he had begun with an issue of 4,000 booklets a week and had had to increase the number. The booklets contain humorous items interspersed with advertising arguments; he found that people would take these booklets home and that they had been the means of increasing his lighting and power business. Another method of extending power business is to go to small factories and shops already equipped with motors, but not intelligently so; to re-equip them so as to secure higher operating economy and take photographs of the meter bills before and after the change, using these photographs as advertising material. He advocated making very low rates to stores for electric signs, show window lights, etc., and taking special care to see that the stores maintained their signs and show window lights in good condition. Mr. Scheuck also pointed out that the lighting company's office should be in a good location and well illuminated at night in order to make a good impression on the citizens. Mr. Converse D. Marsh disagreed with Mr. Scheuck as to methods of getting new business. He thought that methods of getting new business should be the same in character in smaller plants as in large ones, differing only in degree. Promiscuous distribution of booklets he did not consider efficacious. Solicitors could not know who had been reached by the booklets, so that a follow-up system could not be applied; the booklets alone certainly would not bring a man up to the point of signing a contract. Mr. Burnett also disagreed with Mr. Scheuck. He was connected with a company in a city of moderate size and had obtained good results by furnishing free electric signs in order to obtain the resulting business. President Edgar, in response to an inquiry by a member, said that the Boston Edison Company spent 5 per cent. of its gross income in advertising and soliciting new business, this amount being about equally divided between the two branches.

FACTORY ELECTRIC POWER.

The report of the Committee on Purchased Electric Power in Factories, consisting of Messrs. W. H. Atkin, chairman; S. Morgan Bushnell and G. W. Brine, gives the result of inquiries made by circular letter concerning the use of electric power in factories. The letters were sent to all of the members of the Association and asked for answers to 13 questions relating to the charge for power, kind of factories supplied, increase of power business, decrease of production cost from use of electric power, kind of electric drive, amount of power sold, etc. To 462 circular letters sent out 61 replies were received. Of these 19 reported no sales of factory power, 11 either gave no information or answered but one or two questions, and 31 replied more or less fully. The average increase of power business of 24 companies reporting was 37 per cent., a larger amount of increase than the lighting load. The rates reported range from 2 to 15 cents per kw-hour, the usual range being from 4 to 10 cents. Among the conclusions of the report are the following:

The sale of electric power by central stations to factories has been limited largely to such industries as have to carry on their business in the centers of cities or towns where space is costly and where the trouble and danger of steam engines become large factors. The great industries of boots and shoes, cottons and woolens, usually produce their own power.

Among printers there is a large patronage from "job shops" and a good proportion of the newspaper offices, but practically none of the book printers, whose "runs" are long and whose "make-readys" are comparatively short.

The committee considers that the best method to increase business is to educate the prospective customer. Although electric power has been in use for 15 years, it is not yet the first power of which a man thinks when he is about to start a new factory. If the central station could have its solicitor on hand to explain the advantages of electric drive over mechanical drive before the prospective customer has purchased his gas engine or steam engine, or made his contract for power from a belt, a great amount of business might be obtained which is lost simply through unfamiliarity with electric power on the part of the power-using public. In this connection it is of the highest importance that the solicitor be thoroughly conversant with different manufacturing processes, and be a man of great power of observation, so that he can take in the situation quickly and give the customer the needed points which will "tell" and turn the scale to electric drive supplied from central station.

After a customer has been secured he should not be left to his own resources, but should be advised as to the number of motors to purchase and their arrangement. Careful attention to the details of installations at the time the motors are purchased will effect economies, and these will go to the credit of the central station service. The customer is naturally quite reluctant to buy several motors, when, so far as he can see, one will do the work just as well; but the solicitor should have at hand facts and figures that will prove conclusively that the extra motors will return a good dividend upon the investment, and that with the individual motor equipment or the group drive, the central station can supply power more cheaply than the customer can produce it himself.

One great point of economy which should be looked after is the use of the electric elevator in place of that operated by steam or hydraulic power. In many factories may be found a slow-speed freight elevator driven by belts from the main shaft. This can always be changed over and connected to an electric motor without calling on the elevator makers and at comparatively small expense. Another important feature in central station service is the facility with which any single department can be run overtime. This often avoids the employment of inexperienced help, and enables the manufacturer to respond more promptly to any unusual demand. Another exceedingly important factor in the advantages of electric power is the ease with which a plant can be enlarged by merely buying additional motors from time to time, instead of taking out and discarding an overloaded steam plant and putting in a new one at enormous expense, or at least adding long lines of shafting and belting.

The ability to move machines about, taking the tool to the work, instead of the work to the tool, is often a great advantage in large establishments, and this may be done with the greatest facility when tools are directly connected to electric motors. The time saved by this arrangement in shops handling large masses of metal would

pay a very large dividend on the investment in motors. The cleanliness of a shop supplied with motors instead of with shafting would be a revelation to one who was not familiar with the results which such a change in power produces.

HEATING FROM CENTRAL STATIONS.

The report of the Committee on District Heating, consisting of Messrs. E. F. McSherman, D. F. Magee and C. M. Maunsell, gives the result of an inquiry made among central stations operating steam and hot water systems. Of 100 companies addressed, 52 replied, including 36 operating steam and 16 operating hot water systems. The report gives in tabular form the replies to the 24 questions propounded. The conclusions of the committee are that as a whole it seems clear that the companies now in the heating business are in general making money. Out of the 35 steam systems 31 state and show, by the figures returned, that they are well pleased with the investment. Out of 15 operating hot water systems, 11 are satisfied and 4 are not. The best financial showing is made by those companies basing their charge on readings by meter and cubic feet of air space, which insist on the use of economizing coils, inspect and supervise the installation of buildings and refuse to connect or give service to poorly-designed heating systems; and which keep separate accounts of heating and electrical revenues and expenses, and recognize the value a heating system has as an auxiliary to electric light and power supply. It is at least a coincidence that the companies making the poorest financial showing are those that, from a lack of knowledge of what they are actually doing, are unable to make definite or explicit replies to some of the questions asked.

Replies to one of the questions indicate that there is no difficulty in securing or retaining heating patrons, which would seem to indicate that in most cases companies are not receiving as much for heating service as it would cost the customer to supply himself, and consequently it would seem that prices might properly be advanced. The comparative cost of steam heating and coal heating in buildings does not seem to enter into consideration when central station heating service has once been used. The important matter of depreciation has not had the consideration that should be given to it; only 21 of the 52 companies reporting have seen fit to provide for this. Most companies report low cost of repairs, one that has been in business for six years reporting only 2½ per cent. on mains and services. The question of returning condensation to the power house seems to be one related to local conditions. Very few express themselves favorably on constructing a plant for this purpose, though a few are much in favor of it, probably owing to the local situation. The replies seem to indicate that district heating is now a success and could be made more so if central station managers were to co-operate with the committee for the general good. The paper gives the full text of the replies received from all of the central stations which reported.

In the discussion, Mr. McCabe, in answer to an inquiry, said that of the fifty-two companies that had replied to his inquiries only five or six had made any charge to cover depreciation on mains, etc. One company which had been in the heating business fifteen years charged 2½ per cent. for depreciation. Another company which had been supplying heating service for eight years made no charge. Mr. McCabe thought that the depreciation should be taken into consideration, but that it would be very small. He also pointed out that the supplying of heating service enabled an electric light plant to get lighting business in office buildings and other large establishments, which, if they had to maintain heating plants, would also operate their own lighting plants. Mr. Williams, of the New York Edison Company, said that his company had met this argument usually by offering to furnish labor, fuel and supplies for operating the heating plant and to operate the plant at a lower rate than the records of the office building or other establishment had shown the heating service to cost. He said that his offer had never been taken up, but that it had always proved efficacious in combating the argument advanced by the building owners.

OFFICE METHODS AND ACCOUNTING.

Mr. Frank W. Frueauff, in his report on office methods and accounting, confines himself to an account of the methods used in the offices of the Denver (Col.) Gas & Electric Company. The subject is considered under the following heads: Complaints, bureau of information, meter reading, office mistakes, card records, accumulative reports, receipting machine, adding machine, self-adding sheets, slide rule, Thatcher calculator, tube system, tabulating machine and analysis of steam generation. Reproductions of several forms are included in the report. Mr. Frueauff favors the plan of apportioning the cost of operation to the class of current made and of separating fixed and variable costs. The expenses occasioned in manufacturing and distribution for any one class of current should be kept distinct from those incurred in another, so that the actual cost of manufacture and delivering arc power and alternating current may be known separately. The cost for any one class should also be separated to show the costs that are fixed as distinct from those that are variable. For example, station foremen, meter department, shop expenses, etc., are practically a fixed expense, not varying notably as the business increase or decreases. Boiler fuel, firemen, lamp renewals, carbons, etc., vary with output, and under a third head may be included meter, arc lamp and service repairs, meter reading expense, collection and office salaries. With the cost for any class of current separated into these three divisions, it is possible to know just what results are being obtained, and this method is particularly valuable in figuring rates to be made to secure new business. For example, in figuring to take on a long-hour burning customer, it is known from the figures of cost that the fixed cost will not be materially increased nor the consumer's expenses, and that only the output cost will be increased.

At the close of this discussion, the president appointed the Committee on Nominations, consisting of Messrs. P. G. Gossler, New York; D. P. Robinson, Boston; Irvin Butterworth, Denver; W. C. L. Eglin, Philadelphia, and F. E. Smith, Somerville, Mass.

Mr. H. L. Doherty, chairman of Committee on President's Address, then submitted his committee's report. The committee warmly commended the suggestions in the president's address relating to methods for advancing the interests of the Association. It recommended taking quarters in the Union Engineering Building, and suggested the appointment of a reporter to collect data on the thawing of water pipes by electricity in order to deduce something like standard methods for the work and to arrive at a satisfactory basis of charge for such service.

CENTRAL STATION STANDARD INSTRUMENTS.

In a paper entitled "A Proposed System of Standard Instruments for Operating Companies," Mr. H. P. Davis, after sketching the extreme desirability of accuracy of central station measuring instruments, and consequently the necessity of reliable standards for calibration purposes, suggests that a remedy for the present unsatisfactory condition in these respects may be offered by the manufacturers of high-grade electrical instruments. Such manufacturers, it is stated, have the equipment and facilities necessary for the manufacture of portable or semi-portable instruments possessing the desired requisites, and for their certification and periodical checking while in use, with trained and experienced engineers familiar with the problems involved and the means for solving them. Would it not, it is asked, be most natural and advisable for such a concern to design instruments of this nature; to offer them upon a fair commercial basis for the use of operating companies; and thus to give the purchasers the benefit of their exceptional facilities for designing, manufacturing and maintaining their accuracy in use?

The service as rendered by manufacturers of such standard instruments could be advantageously used to cover their care and recalibration after they were put in the hands of purchasers. All the conditions of manufacture combine to make the manufacturers of such instruments the best able to care for them thereafter.

To render the best service under the plan suggested, the manufacturers of the instruments should make no charge for recalibration and should see to it that prompt return is made to the owners. It might even be found advisable to ask owners to send in instruments to be checked when a considerable period has elapsed without such attention. The owner would be at no expense, except for carriage, and should have no hesitancy in sending his instruments to the maker for attention when desired. The testing departments of operating companies would thus be kept in contact with a standardizing bureau or department, whose certificates should rank in excellence with those of the best and most favorably known government bureau or the most famous standardizing laboratories. It is stated that to render such a system successful requires an instrument far superior to all present types, and to cover the field properly the assortment should be made up of voltmeters, ammeters and wattmeters. Specifications are then given as to the design of the instruments answering the necessary requirements.

SINGLE-PHASE ALTERNATING-CURRENT MOTORS.

Mr. W. A. Layman read a paper on "Single-Phase Power Motors for Electric Lighting Stations," which treated the subject under the

following heads: Reliability of single-phase motors; comparative cost of insulation of single and polyphase motors; single-phase motors on polyphase generators; single-phase motors for lighting circuits; single-phase motors for high frequencies; the desirability of motor load for central stations; the special value of motor load to small stations; the day circuit as a factor in the building up of small towns, and power rates for single-phase motor service. The discussion of the subject was based upon the assumptions that the single-phase motor, except for variable-speed work, is to-day the substantial equivalent of the direct-current motor; that polyphase and single-phase types of motors are not competitive, and third, that simplicity of generating equipment and system of distribution are of paramount importance in the profitable development of central station service.

For large plants having polyphase generators, Mr. Layman suggests that the switchboard be arranged for operating first polyphase feeders for all large power and rotary converter service. Second, single-phase feeders for all general lighting service and for all small power work, the switchboard being such that any single-phase feeder may be switched to either phase of the generator buses; where substations are employed similar switchboard arrangements should be made for polyphase distribution in large units and single-phase distribution for all other kinds of service. Third, independent feeder regulations for all polyphase as well as all single-phase feeders. It is stated that the cost of installation of the single-phase motor is actually much less than that of the polyphase; that satisfactory single-phase motor service can be gotten from polyphase generators, and that single-phase motors can be satisfactorily operated from lighting circuits. The New Jersey Public Service Corporation and the United Gas Improvement Companies are installing single-phase motors up to and including 35 hp and the Cincinnati Gas & Electric Company is adding single-phase motors of 15 or less horse-power capacity and considering larger installations individually on their merits. In Chicago motors of 5 hp or less are required to be single-phase and larger installations are considered individually on their merits. Satisfactory single-phase motors can be made for 125 and 133-cycle circuits. There are a number of instances of central stations giving 133-cycle motor service almost up to the maximum capacity of the plant. The paper includes power rates for single-phase motor service as established in Peoria, Ill., and in Cincinnati, Ohio. In the former place the charge varies from 10 cents per kw-hour up to 100 kw-hours per month to 2.8 cents per kw-hour for over 2,000 kw-hours per month and over; 10 per cent. discount being given on all bills paid within ten days. In Cincinnati the basic rate is 10 cents per kw-hour, with discounts varying from 10 per cent. for 100 kw-hours per month to 60 per cent. for over 800 kw-hours per month, there being an additional discount of 5 per cent. on all bills paid within five days.

Mr. J. H. Hallberg stated that the Cincinnati Gas and Electric Company had had to adopt the policy of declining to connect up three-phase motors smaller than 15 horse-power in order to keep down the fixed charges due to the investment for transformers, meters and accessories. They had found that the use of single-phase instead of three-phase motors within the limits mentioned had effected a very considerable economy in fixed charges and had also enabled the company to supply customers whose service would not have been worth obtaining if it had been necessary to run three-phase lines to them and install three-phase transformers, meters, etc. In the case of elevators and other special machinery requiring heavy starting torque, three-phase motors were still used in all sizes.

WRINKLES.

Vying with the "Question Box" in value to all members of the Association, a new department of the Association's work has been initiated in the form of a collection of notes entitled "Wrinkles," giving an account of practical expedients, home-made apparatus, etc., devised by central station men. The editor, Mr. Charles H. Williams, has been able to collect through correspondence no less than 103 items of this character, occupying 107 pages of the *Transactions*. The character of the matter may be judged from the following titles of some of the notes: Truing engine pins; feed water heater on a gas engine exhaust; a home-made traveling crane; repairing a defective boiler crown sheet; keeping a commutator in good shape without turning or sand-papering; a coil-winding machine; running 9.6-amp. lamps and 6.6-amp. lamps from the same machine; reducing standby losses during light load; transformer testing set for line use; locating breaks in series arc circuits; water rheostat used as a starting box; a special transformer for thawing frozen water pipes—there being several notes on this subject; a novel electric sign.

LARGE WATER POWER INSTALLATIONS.

Dr. F. A. C. Perrine presented a paper on Thursday evening which he illustrated by means of lantern slides, giving an account of the genesis of water power electrical generation and describing briefly some plants of this character installed in this country.

ELECTRIC HEATING.

Mr. James I. Ayer presented a very interesting paper on the subject of electric heating, cooking, etc., which will be again noted in later issues.

Mr. Ayer recommended that the plan adopted with respect to arc lamps should also apply to electric heating, and that kitchens and heating outfits of all kinds should be installed free. This system is carried out by the gas companies with great success. The average kitchen for a family of from four to eight persons involves a transformer capacity of about 30 amp. and 3 kw. The average demand of a family of this kind is about 20 amp. and 2 kw at the cooking hour, or about two-thirds the house service. Most of the load for cooking is over by 6 o'clock, so that at most seasons of the year it would not coincide with the peak load. Mr. Alex Dow, of Detroit, said that in Detroit the peak load is in advance of the general maximum lighting in the residence districts, coinciding with the downtown peak. Electrical cooking would add to the main station peak load, but for winter service only. The cooking load is about two hours per day throughout the year. It does not do to sell cooking apparatus unless they are looked out for. An absolutely clean, smooth vessel is better than the ordinary cooking utensil, and the best one is a type of vessel which clamps solidly to the disk. The conducting cords are a unisance, and he suggested that they should be passed through a hole in the table as in the case of telephone switchboard cord. The devices furnished by various makers for varying the heats are about useless in the hands of the ordinary kitchen servant. He considers that two heats are practically sufficient—one quick and one simmering heat—and that these can be obtained by a double-throw switch, which when open cuts the heat off altogether. The worst fault to be found with electrical cooking to-day is in the repair bill, which is a very serious matter. Mr. Arthur Williams spoke of the desirability of circulating among electric light users information relating to electric cooking, and said that the New York Edison Company has recently been doing this extensively. He thinks electric cooking apparatus will never give to the companies a large revenue, since its use is confined to short periods of the day, but aside from cooking the late afternoon dinner in the winter months, whatever revenue comes from this apparatus is additional per kilowatt of installation. This in itself should encourage effort toward installing electric heating and cooking apparatus. In the months of June, July, August and September the load will not come on at the peak, and in view of this it might be well to adopt the English method of making a lower charge for the current used during these months. He considers that every large device connected with electric cooking should have an indicator which cannot be removed and which will show when current is on and off; he has known of cases where the colored lamps supplied with cooking apparatus have been turned out and the current left on. In one case the current was left on an electric heater during the entire summer season in the absence of the owner. He cited a case of a large factory where electric irons are used for making hats; the price paid for current is 8 or 9 cents per kw-hour and the cost of this service is almost identically the same as that of the former service rendered by gas. The advantages in the use of the electric heating iron are that the men work faster, thus increasing the output; the factory and the men working there are kept cleaner; the atmosphere is cooler and working with the electric iron is much less fatiguing to the employees.

THE NEW TICKET.

Some little difficulty was experienced in selecting the new ticket. Mr. J. W. Lieb, Jr., was in direct line, but it was realized that as incoming president of the Institute he had already more than he could well attend to. Among those favorably discussed were Messrs. Arthur Williams, of New York; J. B. McCall, of Philadelphia, and Alex. Dow, of Detroit. A fortunate solution of the situation was found in the final willingness of Mr. E. H. Davis, of Williamsport, Pa., to serve. The efficiency and popularity of this admirable central station manager as secretary have made the powers of the Associa-

tion reluctant to lift him out of that onerous position, but the choice has met with universal approval. The officers elected on Thursday night were as follows: President, E. H. Davis, Williamsport, Pa.; first vice-president, W. H. Blood, Seattle, Wash.; second vice-president, Arthur Williams; executive committee, S. Scovil, Cleveland; A. J. De Camp, Philadelphia; W. F. White, St. Louis.

CONVENTION NOTES.

On Tuesday afternoon a tally-ho ride was given to the ladies through the beautiful suburbs of Boston out to the Country Club as far as the Chestnut Hill Club, where tea was served. The return route lay through Brookline. Several vehicles were needed for the party, and the trip was greatly enjoyed. It was in the hands of Messrs. C. J. Hatch, W. E. Holmes and D. P. Robinson. In the evening a lecture was given in the main dining-room of the Hotel Vendome, on "Historic and Technical Boston," accompanied by lantern slides. The lecturer was Mr. Samuel C. Clough, who did his subject justice in an admirable manner. The technical part of the lecture was prepared by Messrs. L. L. Elden and I. E. Moultrop, the former giving his attention to the electrical development of Boston in general, and the latter taking up more particularly the new Boston Edison turbine station. It was a happy idea thus to fill in an evening in an informational way, and add to the stock of knowledge so agreeably. Everyone was greatly pleased and many compliments were paid to Mr. Larue Vredenburgh on his skill and success as an impresario and lecture bureau manager.

On Wednesday afternoon the whole convention, then about 1,000 strong, was given a steamboat excursion around the harbor, special cars taking the party from the Public Library to the wharf. Lunch was provided on board, and the excellent Salem Cadet Band furnished music. After the circuit of the harbor and out to the seashore line, landing was made at the L Street station of the Edison Company, where all the fine plant was shown in operation. In the new turbine room a dummy turbine of lath and paper was set up to scale on one of the bed plates to show exact size and appearance. On the return voyage landing was next made at the Atlantic Avenue station wharf, where special cars again awaited the party for home. The trip was most delightful and a brilliant sucess, reflecting much credit on the committee, Messrs. Sidney Hosmer, P. Hodges, W. C. Woodward and Prof. H. E. Clifford. Wednesday evening was spent by invitation at a popular concert in Symphony Hall, under the conductorship of Adamowski. The entire lower floor within the rail was reserved for delegates and their friends, and refreshments were also served. The committee in charge were Messrs. P. L. Warner, T. C. Wales, R. N. C. Barnes, George C. Ewing and F. W. Lord.

On Friday, when the practical work of the convention had closed, a number of trips were planned, being scheduled to start at different hours of the day. These included the General Electric works at Lynn, Mr. W. C. Fish; the water power plants at Lawrence, Mass., Mr. R. A. Hale; Salem, Mass., Mr. H. M. Batchelder; Bunker Hill Monument and the Navy Yard, Mr. P. J. Kennedy; Fore River Ship Yards at Quincy, Messrs. C. H. Parker and G. H. Berg; trolley trip, Mr. Paul Winsor; New England Gas & Coke Works, Mr. G. H. Finn; Boston Edison plants, Mr. W. P. Hancock; Boston Elevated system, Mr. Paul Winsor; East Boston tunnel, Mr. R. N. C. Barnes; Harvard College, Prof. C. A. Adams; Massachusetts Institute of Technology, Prof. H. E. Clifford; Simplex Electric Company's works, Mr. E. Morss; Holtzer-Cabot Electric Company's works, Mr. C. W. Holtzer; New England Telephone & Telegraph exchange, Mr. T. C. Wales. In connection with the last-named it must be noted that at certain hours free telephone service to New York was courteously accorded during the convention.

The ladies were by no means forgotten during the meeting. In addition to the entertainments elsewhere noted, and in which they were included, they were given a special tally-ho ride and a splendid run around the suburbs in automobiles on Thursday.

President Edgar is not only to be warmly congratulated on the success and smoothness that attended all his thoughtful and generous provision for the convention—in which an excellent committee co-operated with him—but on the success of the convention *per se*. Note has already been made of the work of the convention, but it remains to be added that no fewer than 1,150 people actually registered, and that of these a record proportion represented the strictly central station element. In fact, nearly 40 States and Territories sent some 400 central station men, from about 200 towns and cities. In connection also with the work of the convention one must commend specially the skillful plans and efforts of Mr. Charles H. Hodskinson, of the Boston Edison Company. One of his wrinkles was an envelope plan, by means of which each delegate could leave his papers, etc., in a numbered pouch just outside the meeting hall as he left and get it again when he entered for the next session. The scheme was a great convenience and worked admirably.

Secretary E. H. Davis and his efficient assistant, Miss H. Billings, had their hands more than full of work, but were greatly gratified at the satisfaction evinced by members at the arrangements and the complete state of the plans, papers, etc. But they were so glad when Saturday came!

Electrical Engineers were present at the convention in goodly numbers, and representative of all ranks and varieties of the profession. Among them may be mentioned Prof. Elihu Thomson, Dr. A. E. Kennelly, R. D. Mershon, J. H. Hallberg, Capt. W. Brophy, P. G. Gossler, Dr. Louis Bell, F. E. Cabot, A. E. Childs, C. J. Field, Dr. S. S. Wheeler, E. R. Weeks, T. D. Lockwood, Dr. P. Pivili, of Milan; Dr. Wm. Habirshaw, R. A. Hale. Educators were also conspicuous, including Prof. C. A. Adams, Prof. H. E. Clifford, Prof. H. B. Smith, Prof. Clarence Feldman, Prof. C. H. Porter, Dr. Louis Duncan.

Large Advertising.—One of the object lessons of the convention week was the appearance of a two-page "ad" in the *Boston Herald* giving a large engraving of the new Boston Edison plant and announcing that after a thorough test of the efficiency of a private plant, that well-known newspaper had reached the conclusion that central station service was better, and that its power and light would be bought hereafter from the Edison system. The capacity of the system was given as 1,380,000 lamps, and it was said that 3,000,000 newspaper readers in and around Boston depended for their daily journals on the ever ready and unfailing service of the Edison Company.

Electrical World and Engineer was represented at the convention by Messrs. J. M. Wakeman, G. W. Elliott, C. T. Walker, W. S. Key, A. D. Adams and T. C. Martin. The current issue of the journal was in demand, not only on account of its articles on the situation in Boston and New England, but because of the interesting historical sketch of what was done at the Boston convention of 1887.

The Technical Press was out in force and in addition to the staff of this journal there were present Messrs. C. P. Poole, C. W. Price, L. Cassier, W. F. Collins, W. E. Keily, F. L. Perry, H. C. Cushing, E. E. Wood, A. E. Clifford, A. L. Rice, J. S. Browning, W. K. Beard, I. A. Bennett, S. C. Cole, C. E. Cornell, Jr., F. C. McDonald, W. T. Hunt, S. A. Goddard, P. S. Dodd, H. S. Tuthill, M. L. Godkin, F. R. White, A. D. Stevens, J. H. Smith, W. F. Hanks.

Mr. E. R. Weeks, of Kansas City, one of the early presidents of the Association, gratified a great many old friends by putting in an appearance. It was the first in some years, and Mr. Weeks was very much impressed, not only with the growth of the body, but with the enthusiasm displayed, equalling, if not excelling, anything he had seen in the past. At the opening session he made a few happy remarks, upon the call of President Edgar.

Mr. F. E. Barker attended the meetings on behalf of the Massachusetts Gas & Electric Light Commission, whose work has been so useful and performed so conservatively.

EXHIBIT NOTES.

Mr. Joseph Sachs, who was attending from Hartford, Conn., has just been awarded the award of the John Scott medal of the Franklin Institute for his enclosed fuse protector, and with blushing diffidence received the congratulations of a host of friends.

Mr. Alex Henderson, who has just returned from South America, appeared on behalf of the conduit interests of the Interior Conduit Company. He was elaborately disguised in a Mexican sombrero and tanned cheekbones.

John A. Roebling's Sons Co. had no exhibit, but were represented by Messrs. F. W. Harrington and G. W. Swan, M. R. Cockey, C. B. Cushing, as well as A. Mann, of Boston. They are said to have distributed souvenirs.

The Westinghouse Exhibit displayed in the parlors on the ground floor of the Hotel Vendome was of especial interest because of the number of new appliances shown for use in electric lighting and central station practice. Much attention was given by the visitors to the Westinghouse type A integrating wattmeter, which

presents several essential improvements over the well-known integrating wattmeters of that company. Single and polyphase instruments in metal cases, single-phase with glass case, and master wattmeters of this type in glass cases for central station use in checking service meters, were shown. Models of the mechanism on a magnified scale were used to show the construction of those portions of the instrument which form its distinguishing characteristics. This type of instrument has been adapted for prepayment service, and the prepayment type A wattmeter attracted much attention. A new type of high-grade portable testing instrument excited very favorable comments on account of its superior finish and attractive appearance. Of this type were shown a voltmeter, an ammeter, a single-phase and a polyphase wattmeter and a power factor meter. They are particularly adapted to central station use on account of the unusual range of scale and the long open divisions of equal length. These scale characteristics make the voltmeter, ammeter and wattmeter more readable at all portions of the scale than any other instrument of this kind. The polyphase wattmeter is the only portable instrument of this kind on the market. The power factor meter is also a new instrument. Portable transformers, mounted in finely finished mahogany cases, were also shown with the measuring instruments. Arc lamps included five different types of styles: Series alternating, multiple alternating, series multiple-alternating and direct-current series and multiple lamps, all of the enclosed type and new designs of high efficiency. The fan motors were represented in the exhibit by several groups of these devices, some of which were effectively utilized to keep the room cool. A type B oil circuit-breaker for switchboard use received considerable attention because of its compact form, simplicity and high degree of insulation. A new departure in standardizing methods was foreshadowed by the display of a new series of precision instruments, having the advantages of the ordinary instrument—portability and convenience—combined with the extreme accuracy and permanency of the Kelvin balance. The Westinghouse exhibit was in charge of Mr. R. L. Warner, New England manager of the Westinghouse Electric & Manufacturing Company, who was ably assisted by the Boston men. A number of the officials of the company were in attendance, the complete list of attendants being as follows: Mr. F. H. Taylor, vice-president, Pittsburg; Mr. Arthur Hartwell, sales manager, Pittsburg; Mr. W. H. Whiteside, manager Detail and Supply Department, Pittsburg; Mr. R. L. Warner, New England manager, Boston; Mr. C. B. Humphrey, manager, Cincinnati, Ohio; Mr. W. F. Fowler, manager, Baltimore, Md.; Mr. H. D. Bayne, manager, Montreal office, Canadian Westinghouse Company, Montreal, Canada; Mr. C. W. Underwood, manager, Buffalo, N. Y.; Mr. G. B. Dusinberre, manager, Cleveland, Ohio; Mr. D. E. Manson, manager, Boston; Mr. Andrew Raeburn, manager, Westinghouse Machine Company, Boston; Mr. C. C. Chappelle, manager, Westinghouse Machine Company, Chicago, Ill.; Mr. Y. L. Brinsmade, manager, Westinghouse Machine Company, New York; Mr. H. P. Davis, assistant chief engineer, Detail Department, Pittsburg; Mr. F. F. Rohrer, manager Direct-Current Department, Pittsburg; Mr. C. W. Register, Chicago, Ill.; Mr. J. B. Comstock, Pittsburg; Mr. Henry Watts, Buffalo, N. Y.; Mr. A. Goodby, Pittsburg; Mr. George W. Pulver, Syracuse, N. Y.; Mr. Frank B. Erwin, Syracuse; Mr. O. T. Smith, New York; Mr. C. E. Skinner, Pittsburg; Mr. E. E. Arnold, Westinghouse Machine Company, Pittsburg; Mr. F. E. Conrad, Pittsburg; Mr. Francis Hodgkinson, Westinghouse Machine Company, Pittsburg; Mr. J. H. Smith, Pittsburg; Mr. Edwin Yawger, Westinghouse Machine Company, Pittsburg; Mr. H. R. Stuart, Pittsburg; Mr. R. L. Rathbone, Detroit; Mr. C. S. Jennings, Sawyer-Man Electric Company, New York; Mr. C. G. Wilson, Westinghouse, Church, Kerr Company, Boston; Mr. S. M. Bramman, Westinghouse Machine Company, Boston; Mr. F. F. Breed, Westinghouse Machine Company, Boston; Mr. J. W. Lucas, Philadelphia; Mr. C. L. Abbott, Boston; Mr. E. D. Mills, Mr. M. H. Merrill, Mr. G. M. Bates, Mr. R. S. Brown, Mr. F. S. Perry, Mr. G. L. Osborne, Mr. G. S Gibbs.

THE SAWYER-MAN ELECTRIC COMPANY, of New York, made its first public display of the "Lumino" lamp. The lamps were used to light a large candelabra in the main Westinghouse exhibit room and attracted very favorable attention because of their brilliancy. The lamp is of 54 cp and shows a remarkably low wattage. A handsomely engraved card, showing the "Lumino" lamp, full size, was distributed to all visitors. A full line of standard incandescent lamps was likewise shown by this company.

PASS & SEYMOUR, Solway, N. Y., the well-known manufacturers of tubes in porcelain and other insulating specialties, were much in evidence in the personages of Mr. B. E. Salisbury, the treasurer, and Mr. John W. Brooks, the sales manager of the company, and Messrs. A. M. Little and Hall, the Boston and New York representatives.

THE ELECTRIC STORAGE BATTERY COMPANY was represented by Messrs. Charles Blizard, sales manager, and J. W. Cook, Boston.

THE STANDARD UNDERGROUND CABLE COMPANY were represented by Messrs. F. C. Crosby, T. E. Hughes, C. J. Marsh, W. C. Waldron.

THE DUNCAN ELECTRIC MANUFACTURING COMPANY, LAFAYETTE, Ind., had an attractive exhibit showing the latest types of their well-known D. C. indicating wattmeters. One of the latest improvements to which special attention was called is the new visual bearing, with threadless jewel post. As the name indicates, this bearing may be readily inspected at any time, and may be quickly removed without unscrewing. Among the other apparatus exhibited were switchboard meters in various designs and finishes up to 5,000 amperes. The exhibit was in charge of Messrs. Thomas Duncan and William H. Sinks.

THE PHELPS CO., DETROIT, MICH., were on hand with an exhibit of "Hylos" in charge of President W. E. Phelps and sales manager, Mr. F. L. Du Broy. "Winking" lamps for sign work were a feature of the display. The new "Lazy Man's" lamp also attracted a great deal of attention. This lamp is operated by a modified knife switch enclosed in a small, compact porcelain case which is attached to covered wires of various lengths. The well-known "pull string" and "turn bulb" types were, of course, shown in great variety.

THE BOSSERT ELECTRIC CONSTRUCTION COMPANY, Utica, N. Y., were represented by Mr. F. G. Scofield.

SPEER CARBON COMPANY.—J. S. Speer, generaal manager of The Speer Carbon Company, St. Mary's, Pa., spent a day at the convention on his way to Maine for a two weeks' outing.

MR. JOHN MUSTARD, who has recently accepted the Philadelphia agency for The Wagner Electric Manufacturing Company, was on hand from the opening session and took full advantage of this opportunity of meeting his many electrical friends.

THE STERLING ELECTRTIC MANUFACTURING COMPANY, Warren, Ohio, distributed an attractive souvenir through Stuart, Howland Co., their New England agents. The souvenir took the form of a tape measure enclosed in a celluloid case on which was data to prove that "Sterling Special" lamps are "sixteen all ways."

MR. J. P. GILBERT, of The Standard Electrical Manufacturing Company, Niles, Ohio, was on hand, of course, to look after the interests of "Star" lamps.

THE AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., was represented by Messrs. Charles R. Bishop and H. C. Eddy.

DOUBLEDAY-HILL ELECTRIC COMPANY, Mr. Charles Phillips Hill, of the Doubleday-Hill Electric Company, Pittsburg, was much in evidence all through the convention, and justly proud of the enormous catalogue which they have just issued, which marks an epoch in electric catalogue making.

THE H. T. PAISTE CO., Philadelphia, was represented by the genial secretary, Mr. E. A. Jenkins.

LOCKE HIGH VOLTAGE INSULATORS as well as other types of insulation made by the Locke Insulator Manufacturing Company, Victor, N. Y., were a prominent part of The Pettingill-Andrews exhibit.

PACKARD.—It goes without saying that the New York and Ohio Company and Packard lamps were ably represented all through the convention by Mr. W. D. Packard, who has missed only two conventions, and on one of these occasions he was abroad.

MR. JAMES G. BIDDLE, of Philadelphia, the well-known dealer in electrical and scientific instruments, took advantage of the convention to meet his many friends in the electrical fraternity.

MR. ARTHUR L. BOSLEY, of The Electrical Material Company, Baltimore, was much in evidence.

THE CROUSE-HINDS COMPANY, of Syracuse, was ably represented by Messrs. A. F. Hiller and C. Blanding as well as by Frank M. Hawkins, of New York, and S. S. Grady, of Boston. While no formal exhibit has been arranged for, a great deal of favorable comment was aroused by the models of the new Crouse-Hinds "Harpoon" guy anchors, which were shown in miniature, and by the literature which these gentlemen diligently distributed.

GENERAL ELECTRIC COMPANY did not make an exhibit, although it occupied a large parlor and dispensed hospitality. On Friday a

party of the delegates visited the General Electric shops at Lynn, Mass., where a great many interesting departments of the work are carried on. During the convention a paper was read on the new "magnetic" arc lamp, which was exhibited in the meeting room. Among the General Electric representatives present were Messrs. J. R. Lovejoy, E. E. Gilbert, W. C. Fish, C. D. Haskins, E. H. Mullin, C. B. Davis, H. W. Hillman, C. T. Moseman, G. T. Bridgman, J. R. Prentice, A. F. Giles, J. B. Pevear, E. D. Mullen, A. D. Babson, E. E. Peaseley, A. W. Ives, J. S. Butler, P. D. Wagoner, D. R. Bullen, H. L. Monroe, F. G. Vaughan, R. Fleming, F. M. Laxton, J. C. Kalisch, W. J. Hanley, J. Scribner, W. T. Wooley, H. L. Monroe, A. D. Page, G. F. Morrison, W. F. Willcox, T. E. Bibbins, H. H. Crowell, J. P. Felton, F. M. Kimball, S. B. Paine, R. B. Hampson, C. B. Burleigh, J. A. Wilson, H. W. Brown, O. F. Brastow, C. W. Fletcher, A. H. Coffin, M. J. Fitch.

J. G. WHITE & Co. were represented by Mr. P. G. Gossler, lately general manager of the Montreal Light, Heat and Power Company, and Mr. H. J. Dowds, both of New York.

THE ALLIS-CHALMERS-BULLOCK interests were represented by Mr. Arthur Warren, manager of the Department of Publicity; Mr. G. H. Berg, manager of the Boston office of the Bullock Company; Mr. H. E. Rundlett, manager of the Boston office of the Allis-Chalmers Company; Mr. J. R. Jeffrey, assistant secretary of the Bullock Electric Manufacturing Co.; Mr. E. W. Goldsmith, manager of the Bullock offices in New York; Mr. E. T. Pardee and Mr. W. N. Ober, both of the Bullock Boston office. Handsome quarters were occupied on the parlor floor, and were filled with large photographs of notable plants and of machines built by the various interests. The rooms were filled at all times with delegates.

STUART-HOWLAND COMPANY.—Among the most energetic and up-to-date firms in New England is the supply house of Stuart-Howland Company, Boston. They occupied handsome parlors at the Vendome and the neatness and care shown in their display was much commented upon. The staff were most assiduous in their attentions to all visitors, and were headed by Mr. G. M. Stuart. There were also in attendance A. H. Howland, A. E. Payne, C. R. Fish, Huntington Lee, C. B. Wetmore, James Wilson and W. Merrett. H. De Steese, of the railroad department, was also in attendance. The principal displays were Dale's wireless clusters, Helios arc lamps and Sterling incandescent lamps. Neat little souvenir whist counters were given away by this company.

STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, had their usual large corps to look after their interests. They occupied large quarters. The staff included Dr. F. A. C. Perrine and R. D. Lillibridge.

THE STANLEY INSTRUMENT COMPANY, Great Barrington, Mass., had on exhibition a full line of their meters which had as exponents W. C. Andrews, S. O. Ochs, E. W. Gough, F. J. Alderson and F. W. Sanford.

MCKENNEY & WATERBURY, of Boston, showed a large line of fixtures and specialties through the attentions of W. A. McKenney, R. J. Green and N. I. Allen, Jr.

THE STANDARD VITRIFIED CONDUIT COMPANY, New York, had a fine exhibit and was looked after by the famous warrior, Capt. B. S. Barnard.

H. W. JOHNS-MANVILLE COMPANY showed a "raft" of their goods through the energetic efforts of Messrs. Joseph Sachs and J. Humphreys.

AMERICAN CIRCULAR LOOM COMPANY had handsome parlors and gave out neat little souvenirs. Their representatives were everywhere and included Mr. A. T. Clark, R. B. Corey and Thomas H. Bibber. A face and figure much missed at this convention from this company were those of Mr. H. B. Kirkland, who was unavoidably absent.

THE PETTINGELL-ANDREWS COMPANY, Boston, exhibited in large and commodious parlors a large line of their various specialties. Their big force of representatives headed by Mr. C. B. Price included Messrs. F. S. Price, Keenan Palmer, Peterson, Johnson, Brokaw, White and Vanstagan.

MR. GEORGE C. EWING, of Boston, looked after the interests of the Cooper Hewitt lamp. He was also a very efficient member of the general entertainment committee.

THE W. S. HILL ELECTRIC COMPANY, of New Bedford, showed a complete line of their switches, switchboards and panelboards. Mr. C. S. Mendell was ever attentive to visitors and was ably assisted by Thomas N. White.

MR. HARVEY HUBBELL, Bridgeport, exhibited some of his admirable specialties in charge of Mr. T. S. McLean.

DALE'S WIRELESS CLUSTER was the subject of conversation wherever Mr. John H. Dale was and that was everywhere about the convention. His friends are legion, and he was in receipt of hearty congratulations on all sides on the immense success this new cluster is meeting with. Such specialties are a great boon to the art, and an incentive to the use of current by the consumer.

SIMPLEX ELECTRIC HEATING COMPANY had a splendid exhibit of the various devices in this new art and was in charge of the veteran J. I. Ayer, who also read an excellent paper on the subject. It also had in attendance Messrs. A. W. Doe, C. W. Richards.

MR. J. H. MASON had much to say for the merits of Simplex Electrical Company's wires and cables.

THE MASSACHUSETTS CHEMICAL COMPANY occupied parlors in the Vendome and their interests carefully looked after by C. E. Farrington and L. O. Duclos. Mr. E. C. Green, president, also took a hand in.

THE HOLOPHANE GLASS COMPANY, as usual made an excellent showing. They were represented by Mr. J. S. Codman, of Hale & Codman, Boston agents.

THE LUNDIN ELECTRIC & MACHINE COMPANY was represented by Emil C. Lundin, who is a veteran in the lighting field. The good points of his various specialties were carefully listened to and appreciated.

CHASE-SHAWMUT COMPANY were represented by H. P. Moore, sales manager, and F. D. Masterson.

THE CONDIT ELECTRICAL MANUFACTURING COMPANY, Boston, had Mr. S. B. Condit, Jr., and Fred W. Nason to talk the good features of the Elden circuit-breaker, and distribute quick-acting cutlery.

"FLEXDUCT" was spoken for by Messrs. C. E. Corrigan and C. B. Roulet, of the Osburn Flexible Conduit Company.

C. F. SPLITDORF found many interested listeners as to the merits of his new arc lamp cut-out.

ATLANTIC INSULATED WIRE & CABLE COMPANY were represented by Mr. G. F. Porter, now master of transportation, and invaluable from his long service and acquaintance as secretary of the Association.

STONE & WEBSTER, Boston, were represented by D. P. Robinson, G. L. Tripp.

ALBERT & J. M. ANDERSON CO., of Boston, were represented by their president, Mr. Albert Anderson.

HOLTZER-CABOT COMPANY, of Brookline, Mass., were represented by President C. W. Holtzer, who took an active part in the proceedings.

NATIONAL ELECTRIC COMPANY, of Milwaukee, sent Mr. M. E. Baird to speak for its dynamos and motors, now becoming so widely known.

ELECTRIC CARRIAGE CALL COMPANY made signals through Mortimer Norden and T. G. Bloomberg. It had an exhibit of much interest in its electric signs and calls.

STANDARD CHEMICAL COMPANY sent on G. B. Davis, president and manager.

ELLIOTT ADDRESSING MACHINE COMPANY gave an admirable actual demonstration of what their machine could do. Mr. W. C. Mills, Boston manager, handled the exhibit with Mr. E. E. Mills, manager.

PHOENIX GLASS COMPANY were fortunate to have present their veteran and popular manager, Mr. A. H. Patterson, with Mr. E. H. Peck as an affable "understudy." Mr. E. P. Elberts also helped them.

C. S. KNOWLES was represented by Messrs. C. H. Clark, Duncan Kennedy, G. Ober, G. S. Hutchins, J. Keefe, H. M. Saben.

WESTON ELECTRIC INSTRUMENT COMPANY had on hand their Boston manager, Mr. G. H. Moseman.

MR. GEORGE CUTTER, of Chicago, was a worthy and typical exponent of Western sentiment and progressiveness.

BUCKEYE ELECTRIC COMPANY were represented by Mr. Le Roy P. Sawyer from the Cleveland office.

BRYAN-MARSH COMPANY had a good delegation in Guy V. Williams, J. P. Williams, D. W. Eyman, E. H. Houghton, G. C. Keech, S. E. Doane, F. W. Godfrey, W. C. Ballda. Converse D. Marsh was off somewhere regaling his cronies with Rabelaisian reminiscences; and draughting ads and other things.

"OKONITE" delegation, like its trade mark, was twain. Its two halves, of course, were Willard L. Candee and G. T. Manson. These veterans have sometimes been seen apart, but not at a convention.

When the next Association amateur theatricals are given they are to play Damon and Pythias. They may be tempted to play the two Dromios.

NATIONAL CONDUIT & CABLE COMPANY had an excellent delegation in President George J. Jackson—"white"—and Messrs. W. S. Eckert, F. S. V. Sias, J. B. Honan, J. A. McQuale, Jr.

MR. F. W. LORD referred occasionally to the Lord Electric Company.

MR. C. O. BAKER was most unfortunately unable to attend, but the interests of Baker & Co., Inc., platinum, were well cared for by Mr. J. J. Lowthian.

ELECTRIC GAS LIGHTING COMPANY, of Boston, had an apparently ceaseless flow of representatives on tap. They "kept coming." Some of them answered to the names of W. F. Abely, K. L. Norris, F. H. Sherman, A. H. Boardman, C. H. Howes, C. E. Lee, S. A. Koltonsai.

AMERICAN DIESEL ENGINE COMPANY has no big American station yet like the Boston Edison, but Mr. Norman McCarty wept salt tears when he saw so much good money being wasted there on steam turbines. Sobs broke his utterance every time he spoke of it. And he had figures to prove it, too. With him was their assistant engineer, Mr. J. D. McPherson.

LOMBARD GOVERNOR COMPANY had a strong engineering delegation in Dr. Allan V. Garratt and Mr. R. B. Smith. With them was R. B. Stafford.

MCINTOSH, SEYMOUR COMPANY were influentially represented by Messrs. J. A. Seymour from Auburn, N. Y., and by Mr. E. A. Merrill, of the New York office.

AMERICAN ELECTRICAL WORKS, of Providence, R. I., sent Mr. T. B. Baker from the Phillipsdale works and Mr. W. J. Watson from Gotham.

AMERICAN DISTRICT STEAM COMPANY, Lockport, N. Y., placed their interest in the hands of Messrs. C. R. Bishop and H. C. Eddy.

NATIONAL CARBON COMPANY were represented by Manager N. C. Cotabish from the Cleveland home circle and by Messrs. F. H. Murray, J. C. Irvine, J. F. Kerlin, F. C. Park, A. D. Spear.

MR. B. S. Barnard, the energetic president of the Standard Vitrified Conduit Company, got many a friendly handshake.

WAGNER ELECTRIC MANUFACTURING COMPANY were well represented by Messrs. Layman and Godfrey from out the West, as well as by Mr. B. Faxon, of their Boston office. They had a nice parlor on the first floor. Mr. John Mustard also greeted many old friends in his capacity as a Wagner man from Philadelphia.

ALBERGER CONDENSER COMPANY found their topic quite interesting to many central station men, and President L. R. Alberger and H. M. Montgomery were busy all the week getting in touch.

CROCKER-WHEELER ELECTRIC COMPANY, of Ampere, N. J., was represented by its president, Dr. S. S. Wheeler, and Secretary A. L. Doremus, and by R. N. C. Barnes, C. R. Metchear, A. J. Newell.

SHELBY ELECTRIC COMPANY, of Shelby, Ohio, was represented by Mr. C. W. Cartwright.

NERNST LAMP COMPANY found an efficient agent in Mr. George C. Ewing, who also proved a very competent and indefatigable local committeeman. He was aided by Mr. R. T. Vredenburgh, Mr. M. W. Hanks, Mr. E. R. Roberts, Mr. F. Gibbs.

SPRAGUE ELECTRIC COMPANY had present Messrs. H. G. Issertel, of its engineering staff, and Messrs. H. C. Farnsworth, A. Henderson.

GENERAL INCANDESCENT ARC LIGHT COMPANY sent Messrs. P. H. Klein, A. Foster, its Boston manager; F. Raymond, R. S. Hale, S. H. Blake.

MARSHALL SANDERS COMPANY was represented by Mr. Norman Marshall and C. A. Sanders.

H. S. POTTER ELECTRIC COMPANY were spoken for by the principal of that name.

MR. FRANK RIDLON needed no introductions to any central station man or supply man either. He was the Nestor of the convention, and fell easily into narrrtive, beginning "In the year one—." With him were E. W. Kellogg and N. L. Wood.

TRENTON PORCELAIN WORKS, with Messrs. George E. Maguire and Russell Howland, had the right blend of oratory and convincing "selling points."

WESTERN ELECTRIC COMPANY was one of the few Western houses making anything of an effort to be on hand. Mr. E. W. Rockafellow came up from New York to show that Chicago still remembers where the telephone started. With him was Mr. A. C. Morse.

DEARBORN DRUG & CHEMICAL COMPANY, of Chicago, were very adequately represented by Messrs. W. H. Edgar and W. B. McVicker.

FORT WAYNE ELECTRIC WORKS had a very handsome exhibit in one of the main ground floor parlors of all their well-known specialties in meters and other lines, while their famous little breeze circulators infused a grateful coolness into many a nook and corner of the room, the meeting hall, the committee rooms, and the hotel generally. The company was largely represented, its staff including Messrs. J. A. Smith, T. L. Sturgeon, J. C. Lott, F. S. Hunting, J. W. Hilgeman, J. Kent, A. A. Serva, J. O. Spear, Jr.

DOSSERT & Co., of New York, sent President J. J. Dossert and Secretary A. H. Willmont to safeguard their interests.

PRESIDENT B. C. KENYON, of the Diehl Manufacturing Company, was not able to arrive until the convention was in full swing, but he was not slow in "getting into the game" and helping to keep the ball in play. The company is extremely busy in all branches of its dynamo electric machinery.

CANADIAN GENERAL ELECTRIC COMPANY were represented by Mr. E. D. McCormack and Mr. A. B. Lambe. Young Mr. Nicholls was also present for himself and his father, Past President Frederic Nicholls, one of the best executives the Association ever had.

MR. RAY D. LILLIBRIDGE came during the week in behalf of the interests of his technical publication and advertising bureau, which has so large a patronage in the electrical and mechanical fields.

SUPPLY MEN were legion, as will be gathered from the items herewith as to exhibits and companies represented. The light and power art is throwing out its fibres and roots in various directions and bringing many industries within its scope. In addition to the concerns already noted, with the names of their sponsors, may be given the following, somewhat in order of registration: Federal Electric Company, W. H. McLain; Chicago Fuse & Wire Company, W. E. Weinsheimer, R. W. Smith; Manhattan Electrical Supply Company, J. W. McDonald; Bryant Electrical Company, F. V. Burton; Peerless Electric Company, A. Dunlop; De Laval Steam Turbine Company, C. Garrison; Benjamin Electric Manufacturing Company, B. G. Kodjbanoff; Safety Insulated Wire & Cable Company, F. B. Parsons; C. H. Whall & Co., F. R. Whall; Wheeler Reflector Company, H. C. Hawks; Munder Electric Company, C. F. Munder; Crescent Gas & Fixture Company, H. S. Beaman; Triumph Electric Company, C. A. Cotton; Kimmey Electric Company, C. A. Brown; Jandus Electric Company, E. L. Nash; Kinsman Electric Railway Supply Company, F. E. Kinsman; Ballou-Hutchins Electric Company, C. A. Ballou; Washington Carbon Company, J. S. Crider; Phillips Insulating Wire Company, A. N. Palmer; D. & W. Fuse Fuse Company, W. S. Sisson; R. D. Wood & Co., C. W. Lummis, H. G. H. Tarr; Re-New Lamp Company, G. H. Smith, H. Hastings; Tipless Lamp Company, R. S. Carrick; Crescent Insulating Company, L. F. Jackson; Magnet Wire Company, H. Hill; The Wire & Cable Company, E. F. Sise; Marion Insulated Wire & Rubber Company, J. L. Lucas; Fostoria Incandescent Lamp Company, H. S. Potter; Novelty Electric Company, C. E. Trump; Emerson Electric Manufacturing Company, E. L. Barkhouse; Electric Material Company, A. L. Bosley; Power & Mining Machinery Company, F. P. Thorp; Warren Arc Light Company, J. A. Stewart, I. P. Frink, Frank Stout; Sibley & Pitman, F. S. Gardner; Adams-Bagnall Electric Company, G. A. Thomson; Standard Varnish Works, J. C. Dolph; Lawrence Gas Fixture Company, C. V. Daiger; Buckeye Engine Company, A. K. Ashworth; E. B. Latham Company, E. B. Latham; National Wire Corporation, F. B. Parsons; Page Electric Company, J. P. Coghlin, F. S. Miller; New Britain Machine Company, R. S. Brown; Standard Electrical Manufacturing Company, J. P. Gilbert; Independent Incandescent Lamp Company, W. M. Rothschild; H. B. Camp Company, C. C. Baird; American Vitrified Conduit Company, S. A. Douglas; Wirt Electric Company, W. J. Thompson; Fred J. Lucey, of F. J. Lucey Co.; Sampson & Allen, A. T. Sampson; T. F. Carey Co., Thomas F. Carey, C. H. Currier; Hewes & Phillips Iron Works, Franklin Phillips; McMichal & Wildman Company, F. B. Wildman; Ansonia Brass & Copper Company, R. A. Cowles, F. H. Sherwood; Nightingale & Childs Co., E. G. Crosley; Charles A. Schieren & Co., G. H. Hamblett, E. A. Usina; National Biscuit Company, E. F. Cullen; American Steel & Wire Company, R. K. Sheppard, V. Goldthwaite, F. A. Keyes, A. F. Walker; Gillender & Son, Inc., W. Croft, Jr.; India Alkali Works, C. P. Powers; M. K. Kendall & Co., M. K. Kendall;

Packard Electric Company, Canada, G. C. Rough; White Automobile Company, T. H. Tucker; J. Wilkinson & Co., L. C. Billings; H. L. Slade; Bates & Neilson, J. Neilson; National Pipe Bending Company, W. G. Ruggles; M. W. Dunton Co., F. Chapman; Dwyer Machine Company, E. F. Dwyer; Potter & Earle, J. L. Potter; Heine Safety Boiler Company, E. L. McGregory; New England Machine Company, F. W. Smith; Macbeth-Evans Glass Company, E. S. Briggs, M. B. May; Gamewell Fire Alarm Telegraph Company, H. E. Stover; Falls River & Machine Company, G. A. Irving, E. J. Electric Insulating Company, M. H. Stearns; Colonial Electric Company, W. F. Curtis; W. Frederick Swift & Co.; J. H. Hallberg; Fields-Foulk Company, C. J. Fields; Standard Paint Company, L. G. Goodrich; Bryant Electrical Company, W. C. Bryant, F. V. Burton; American Brass & Copper Company, Randolph Osborn; Standard Optical Company, J. E. Bowker; Alphaduct Manufacturing Company, Russel Dart.

HABIRSHAW."—It was a great pleasure to see the interests of the India Rubber and Gutta Percha Insulating Company represented by the "good gray" Doctor himself. Besides Dr. W. M. Habirshaw, it sent Mr. J. B. Olson, the suave sales manager from New York.

RICHMOND ELECTRIC COMPANY sent Mr. W. H. A. Davidson, who met many old electrical friends.

MR. F. S. TERRY, of the Sunbeam Incandescent Lamp Company, and the animating genius of the incandescent lamp pool was a late arrival, but none the less conspicuous. He was not allowed to lack opportunities for conversation. With him was Mr. B. G. Tremaine, the well-known manager, etc., of the Fostoria Incandescent Lamp Company.

GOULD STORAGE BATTERY COMPANY did not make an exhibit, but were energetically represented on the firing line by Dr. W. E. Winship and E. L. Draften.

DE LA VERGNE MACHINE COMPANY were welcome strangers, and were able to send very acceptable representatives in George Richmond, Seward Babbitt and H. Borgstedt.

NEW YORK INSULATED WIRE COOMPANY referred to several big buildings in Boston as exhibits, and for other cities left its testimonials in the hands chiefly of Mr. James Wolff, of Chicago, and W. B. Fearing.

SWAZEY & SMITH CO. were represented by H. W. Smith, T. Dun, G. H. Swazey.

CENTRAL STATION MEN.

The central stations of the country were more largely and widely represented than at any previous convention. Those registering were as follows:

ALLEGHENY, PA.—C. S. Mitchell, C. E. Warner.
ALLIANCE, OHIO.—D. W. Law.
ALTOONA, PA.—E. B. Greene.
AMESBURY, MASS.—H. A. Sawyer.
AMHERST, MASS.—D. Barry.
ASHEVILLE, N. C.—H. W. Plummer.
ATLANTA, GA.—T. J. Harper, A. L. Balsley.
ATTLEBORO, MASS.—E. Fregoning, H. Daggett.
AUBURN, ME.—H. T. Sands.
AUBURN, N. Y.—J. S. Wise, Jr.
AUGUSTA, GA.—H. V. Schreiber.
BALTIMORE, MD.—J. F. Dusman, Douglass Burnett.
BANGOR, ME.—J. W. Cartwright.
BENNINGTON, VT.—E. E. Larrabee.
BIRMINGHAM, ALA.—J. M. Bradley, R. Jemison.
BOISE, IDAHO.—D. Blanchard.
BOSTON, MASS.—C. L. Edgar, E. S. Mansfield, L. L. Elden, L. Vredenburgh, W. H. Atkins, L. M. Wallace, C. J. Hatch, G. V. Rowe, S. Hosmer, C. H. Parker, J. E. Larrett, F. S. Wilson, P. Winsor, C. D. Walker, A. S. Knight, C. H. Hodgkinson, A. H. W. Jaynes, I. E. Moultrop, S. J. Lent, E. H. Belden, W. D. Dyer, C. H. Ingalls, J. C. Redmond, W. P. Hancock, J. S. Vogler, D. Goss, A. C. Gray, G. P. Wisdom, H. P. Driver, C. R. Brown, W. Carrasco, A. G. Pierce, L. L. Edgar, J. W. Cowles, W. P. Fiske, W. H. Francis, G. Goettling, S. C. Clough, C. H. Herrick, W. W. Cummings, E. L. Caldwell, J. T. Boyd, W. T. Willey, W. C. Ross, G. B. Adams, W. E. Cook, H. F. Leavitt, F. Marshall, J. S. Cartwright, J. L. Bayle, E. B. Spike, T. F. Malone, G. W. Moses, F. B. Pitcher, F. V. Edgell, J. E. Elliott, W. H. Gardiner, Jr., W. J. Kennedy, P. Kent, R. E. Curtis, F. Brophy, F. D. Stiles, E. E. Phipps, W. H. Spaulding, F. Willis, C. F. Baker, G. S. Lawler, T. I. Donahue, H. E. Cutler, J. Y. Bradbury, B. Houghton, G. Attwood, E. J. Beugler, A. W. Friend, E. Mahler, A. E. Griffin, S. F. Lunt, W. C. Swan, H. F. Elden, F. G. Havlin, C. W. White, C. W. Enright, W. Minkler, W. E. Pierce.
BRAINTREE, MASS.—W. P. Mercer.
BRATTLEBORO, VT.—L. C. White.
BRANDON, VT.—E. D. Blackwell.
BRIDGEPORT, CONN.—W. T. Oviatt.
BRIDGETON, ME.—C. A. Badwell.
BROCKTON, MASS.—P. Player, F. S. Pratt.
BROOKLINE, MASS.—G. E. Crosby, J. A. Gould, J. W. Dodd.
BRUNSWICK, ME.—A. C. Hopkins.
BUFFALO, N. Y.—W. R. Huntley.
BURLINGTON, VT.—F. H. Parker.
CAMBRIDGE, MASS.—F. H. Raymond, R. A. Faye, W. R. Eaton.
CHICAGO, ILL.—L. A. Ferguson, W. M. Anthony, J. H. Gilchrist, R. L. Elliott, G. N. Eastman, W. L. Abbott, P. Junkersfeld.
CHELSEA, MASS.—H. W. Moses.
CINCINNATI, OHIO.—W. Von Phul.
CLEVELAND, OHIO.—S. Scovil, S. C. D. Johns, M. E. Turner.
CLINTON, MASS.—R. R. Mackenzie.
COHASSET, MASS.—E. W. Bates.
CONCORD, MASS.—A. W. Lee, G. B. Lauder.
CONNELLSVILLE, PA.—L. Hill.
DENVER, COLO.—I. Butterworth, H. L. Doherty, C. W. Humphrey, W. J. Barker.
DES MOINES, IOWA.—F. L. Dame, R. H. MacMillan.
DETROIT, MICH.—A. Dow, E. F. Phillips.
DOVER, N. H.—T. Hawken.
EASTON, PA.—M. A. Maxwell.
ELMIRA, N. Y.—H. M. Beugler.
EL PASO, TEX.—H. T. Edgar.
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HARTFORD, CONN.—A. C. Dunham, R. W. Rollins.
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HUDSON, MASS.—W. G. Lawrence.
JACKSON, MICH.—W. P. Stephens.
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JOLIET, ILL.—J. R. H. Staley.
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LEAVENWORTH, KAN.—A. S. Cook.
LEBANON, PA.—F. C. Wright.
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NASHVILLE, TENN.—J. P. W. Brown.
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WOODSVILLE, N. H.—G. E. Mann.
WOONSOCKET, R. I.—F. S. Pond.
WORCESTER, MASS.—H. H. Fairbanks, W. H. Coughlin, F. H. Smith.

DEATH OF WILLIAM WALLACE.—Every electric lighting man was grieved to learn during the convention of the death on Sunday last, in Washington, of Mr. William Wallace, who did so much pioneer work, for himself and with such men as Prof. Farmer to develop arc lamps, dynamos, carbons and other features of the industry. Many of the convention knew him and admired his fine personality.

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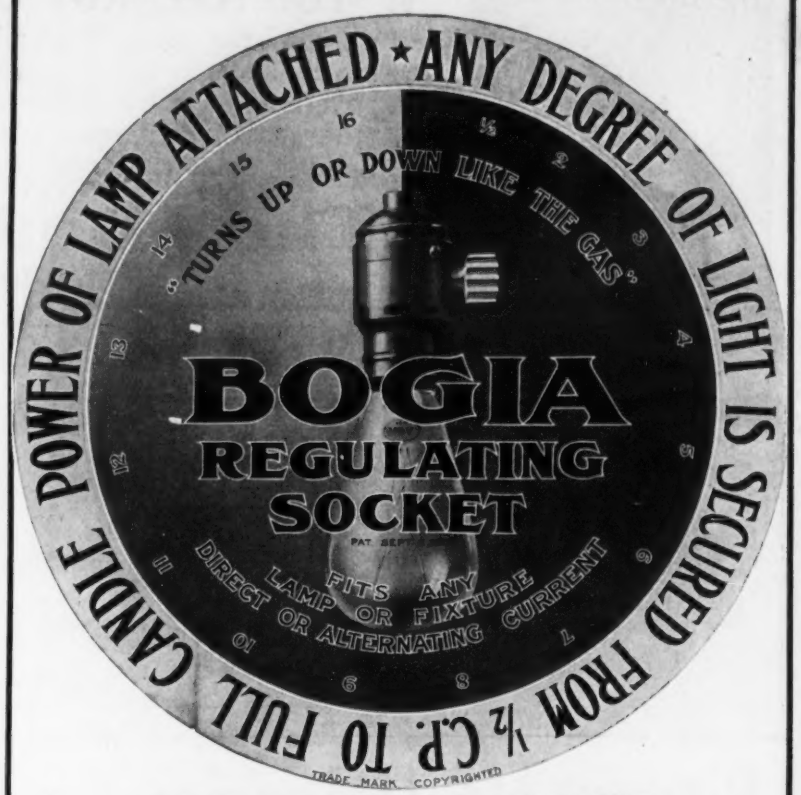
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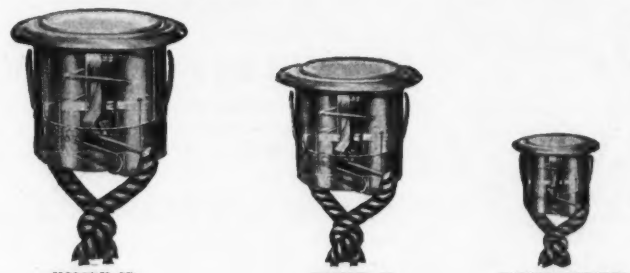

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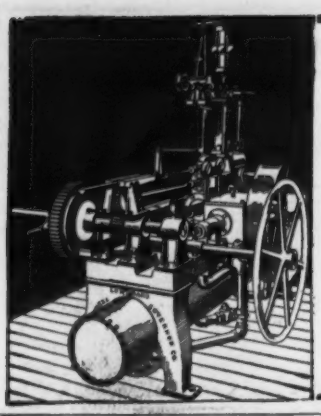

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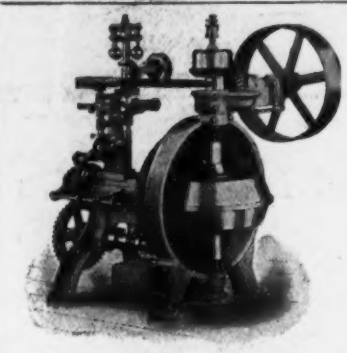

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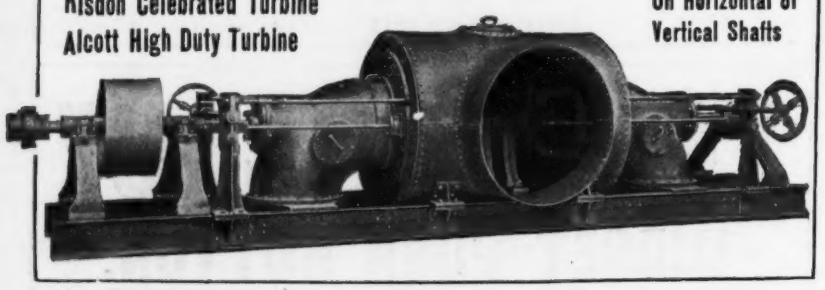

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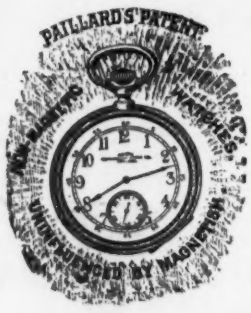

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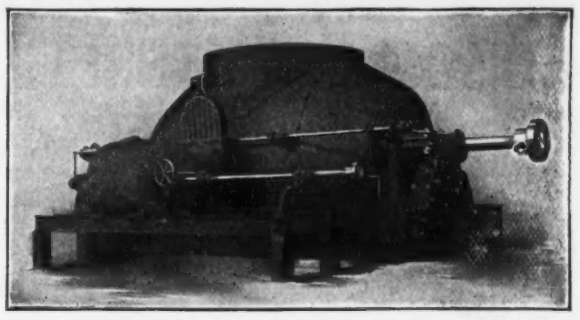

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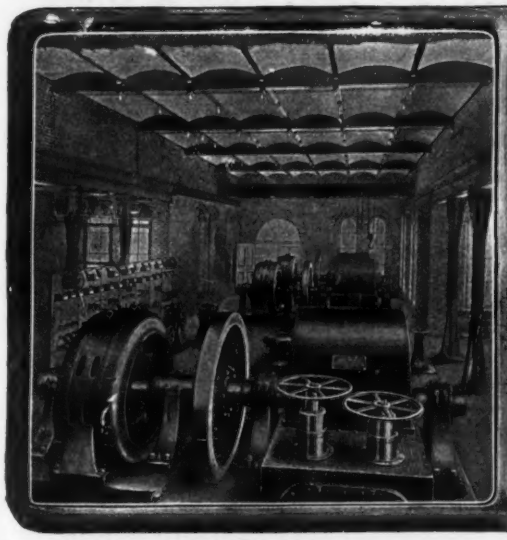

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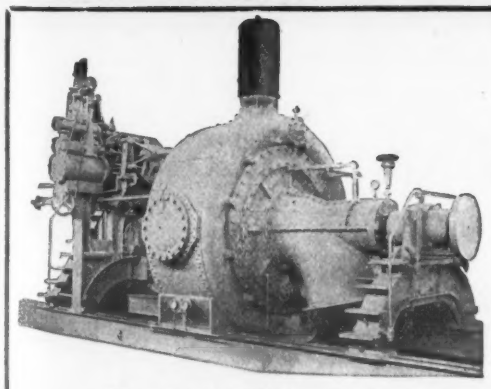

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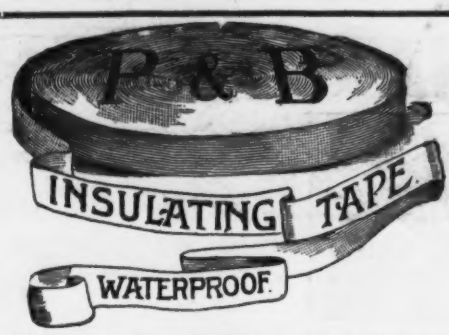

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